SEVENTY-FOURTH YEAR

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Light weight Browning gun used as a rifle

Preliminary Facts Concerning the Browning Guns

THE curtain of secrecy has at last been raised, revealing to an anxious audience the light and heavy Browning guns. The occasion was the official demonstration on February 27th at Congress Hill, a few miles out of Washington, D. C., in the presence of members of Congress, Army representatives, foreign military attaches and fifty or more reporters.

So the light weight Browning gun and the heavy duty Browning machine gun are no longer a mystery. The former is practically a rifle, an automatic rifle, weighing 15 pounds, while the latter is a machine gun very much along the lines of the Maxim in appearance, weighing but 34½ pounds. Both guns handle the same ammunition that the American forces in France will use in their Springfields and modified Enfields, namely, the rimless .30 caliber, cupro-nickel jacketed cartridge, which develops a pressure of 50,000 pounds to the square inch at the moment of discharge. Thus the ammunition will be interchangeable between all four weapons, which is an important consideration at the battle front.

Taking up first the light Browning gun, this weapon may be described as a rifle with automatic and semi-automatic action. That is to say, it can be employed for continuous fire, emptying its entire magazine in rapid order at the command of the trigger, or it can be employed as a self-loading and self-cocking rifle, in which case the rifleman pulls the trigger for each shot. In tests the gun has discharged its 20 rounds in 2½ seconds.

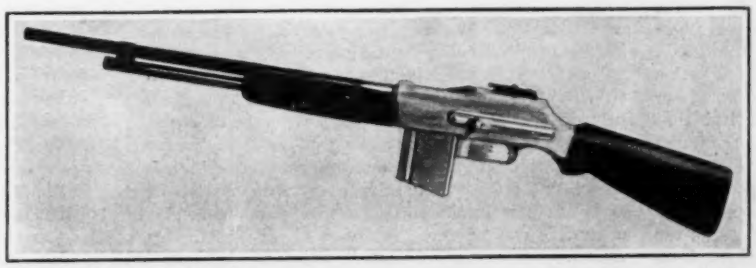
The Browning light gun or machine rifle, as it is designated by the Army officials, is of the air-cooled, gas-operated design. It may be fired from the shoulder, the rifleman finding his target over sights identical with those used on the new United States rifle, model of 1917, or from the hip, the rifleman finding his target by his general sense of direction, the latter being a knack quickly acquired through practice.

The principle of gas operation is simple. The gun is cocked with an easily operated handle for the first shot. The bullet is expelled by gases, which, as already stated, exert a maximum pressure of 50,000 pounds to the square inch. A small portion of this powder gas is taken off by the gun mechanism to act as power to operate the gun automatically. A bullet discharged from this gun has approximately the same energy as that fired from the United States rifle, model of 1917, or from the Springfield service rifle. Cartridges are fed from a detachable magazine containing 20, or for special purposes 40, service cartridges. The magazines may be detached by merely pressing a button and a new magazine attached by one motion, this changing operation requiring about two and a half seconds.

The gun may be operated as an automatic or as a semi-automatic arm by the manipulation of a conveniently-located lever. By putting the lever in the first position, the gun is made to fire single shots by trigger release; by putting the lever in the second position the gun becomes an automatic and will fire 20 shots in from two and a half to three seconds; the third lever position is the "safe" or locking device. It is said by the military authorities that the designer intended the gun to be used more as a semi-automatic than as an automatic arm.

Powder gases create terrific heat, sometimes developing the destructive temperature of 4,000 degrees Fahrenheit. An air-cooled automatic gun, therefore, has its limitations. The Browning rifle has an open and very simple construction and cools remarkably quickly. The rifleman may fire 350 continuous shots from it without having to stop and cool the weapon.

The chief characteristic of the gun is its extreme simplicity of construction, rendering the manufacturing problem correspondingly simple. It has fewer than twenty principal parts and possesses the great advantage of standardization, being easily and quickly taken apart and reassembled by the ordinary soldier. From the manufacturing viewpoint, the gun possesses the great advantage that it may be promptly produced in large and increasing volume as shop machinery is multiplied and operating personnel developed.



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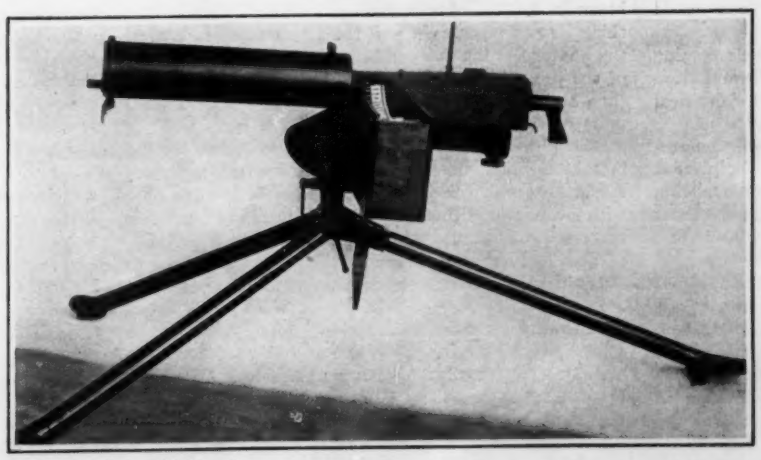
Light type of Browning gun which weighs 15 pounds



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Heavy type of Browning machine gun which weighs 34½ pounds

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Firing the light Browning gun from the hip position

Used cartridges are ejected from the side of the gun, never crossing the sight of the rifleman, and coming out with sufficient force to clear themselves beyond his notice. A feature of the rifle is that the cocking handle remains stationary when the gun is in operation and is so arranged that it will in no way hamper the gunner, thus eliminating a danger common to many guns.

The gunner may operate the gun at all times without aid. Only one tool, a small wrench, is needed to care for the gun, as most of the operations of taking it down and reassembling may be performed by use of a cartridge as a tool.

As the gun is intended for the use of charging infantry, the problem of ammunition is naturally an important one. In this connection we are told that the gunner carries approximately 120 rounds of ammunition in his belt or bandolier and his two assistants carry 400 and 240 rounds, respectively, loaded in magazines. The loaded magazine weighs one pound 7 ounces. Thus it is possible for a gunner to go into battle with a supply of about 800 rounds of ammunition.

Equally interesting is the heavy Browning gun, which is of the water-cooled, belt-feed design, and is operated by means of the power created by the recoil action. It is fed from a cotton belt which contains 250 rounds of service cartridges. The belts may be rapidly loaded by means of a machine which is a development of the one which Mr. Browning devised some twenty years ago in connection with the Colt gun.

Like the light gun, the heavy-duty Browning piece is marked for its simplicity of construction, rendering manufacturing problems easy and giving it a high degree of endurance. In the Government test 20,000 rounds were fired from this gun with only three stoppages, one being due to a defective cartridge. In a further test firing was continued with the same gun to 39,500 shots, when the gear gave way. A duplicate gun fired 20,000 shots in 48

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

A German General on the Next War

WITH increasing frequency during the past few weeks it has been stated that Germany is already giving evidence, in her thoughts if not by her deeds, that she is preparing for the next war, and nowhere has this evidence been more direct than in a book written by Lieut. General Baron von Freytag-Loringhoven, which bears the title, "Deductions from the World War." The General is Deputy Chief of the General Staff, and before assuming that office he was the predecessor of Ludendorff as Quartermaster-General in the field. Because of his high rank we are entitled to believe that he expresses the views and the aspirations of that military party which is still holding the German people in the hollow of its fist.

We are not so much concerned just now with his technical deductions, which have in them nothing strikingly original. As was to be expected, he indicates the great importance of good railway communications, which enabled Germany to move rapidly large bodies of troops between the eastern and western fronts, and made it possible for the French to execute similar rapid movements in mass during the Battle of the Marne and in the subsequent trench warfare. He acknowledges the great service performed by the motor truck. In speaking of aircraft he shows evidence of a characteristic German self-complacency in his statement that the Germans have established increasingly their superiority in the air. He admits that in land warfare the airplane has superseded the Zeppelin.

Of greater interest is his statement that the Germans' defeat on the Marne was due to the fact that they had not sufficient numbers to put through their plan of enveloping the Allied Army; to do that they would have required nothing less than another army operating in echelon on their right flank.

It seems to be impossible, judging from this book, for any German, not even a high-ranking military man engaged in deducing the technical lessons of the war, to speak of the conflict without drawing a contrast between the base motives and unworthy spirit of the enemy and the purity of spirit with which Germany, in mere self-defense, is meeting their outrageous attack. England, we are told, "is waging a commercial war with a view to her own enrichment and the annihilation of her chief rival"; and "the French officers have lost that chivalrous sentiment which, as late as 1870, found expression in the words of an old Frenchman, 'the person of a prisoner is sacred.' These degenerate people jeer at and ill-treat our prisoners in the most flagrant manner," etc. Not so, Germany, however. "In the case of the Central Powers, that lofty moral strength arising from the sense of righteous self-defense in a war which has been thrust upon them, showed its superiority to the zeal which a commercial and hereditary war could kindle in our enemies."

Can we be blamed if we pronounce such words, coming from the mouths of the men who authorized the organized villainies in Belgium, as anything else than hypocritical and altogether nauseating cant and humbug?

Although the General does not, of course, put it down in bald English that Germany has failed in the present war, it is impossible to read this work without realizing that the Grand General Staff understands that the great stake for which they played is lost—at least for the present. Be that as it may, the thing which stands out with most sinister significance in this book is the fact that the German High Command is studying the lessons of the failures of this war, with a view to applying them in another attempt on an even more widely extended scale. While the Allies are waging this war for the purpose of establishing, if not perpetual at least an extended period of peace, by smashing up once for all the belief of Germany in its military invincibility and in its ultimate God-given destiny to rule the world by virtue of its military prowess, this von Freytag-Loringhoven gives us to understand that Germany would make this war with all its vast experience, the stepping-stone for another attempt which shall surely win out. He tells us that nobody can undertake to guarantee a long period of peace; that a lasting peace indeed can be guaranteed only by strong armaments. "In the future," says he, "as in the past, the German people will have to seek firm cohesion in its glorious army and its belaureled young fleet."

We are very glad that Freytag has written this book, and that within its pages he has revealed to us so clearly the incorrigible spirit of these swash-buckling war lords. How far the German people as a whole subscribe to this philosophy nobody outside of Germany can tell; but there is cumulative evidence that if not with the lip, at least in the heart, the German people are as unrepentant as their military masters.

Be it so; and the lesson of this latest effusion from the Treitsche-Bernhardi-Hindenburg-Wilhelm school for the embattled hosts of modern civilization is, that the German military bully must be beaten to that ultimate point at which he will whimper like a whipped hound.

Getting the Soldier to Think

"HIS not to reason why, his but to do or die," is what Lord Tennyson once said regarding the disciplined soldier. And, indeed, that has been true until quite recently, when commanders have seen fit to take each and every officer and private into their confidence.

Your soldier of today is allowed to think; in fact, he is encouraged to think for himself. In the majority of big offensives, every man who is to participate in it is taken into the confidence of the general staff in order that he may know how the action is going to develop. Take a concrete case: Prior to the battle of Messines Ridge, the British prepared an elaborate relief map of the region of the contemplated attack, which required more than six months to complete. Instead of inches, this map was scaled to yards; and every German trench, house, pill-box, tree, dugout, road and other feature of the ground to be traversed was there in diminutive form, right where it could be studied by Tommy Atkins. The initial information for this map, of course, had been obtained by the observers and photographers of the Royal Flying Corps; and to keep this map strictly up to the minute was the task of these airmen. Every change made by the Germans was caught on the negatives of the aerial cameras, then detected and interpreted by those eagle-eyed, analytical-minded "photograph readers" back of the lines, and shortly after duly transferred to the miniature Messines Ridge. Thus the prototype and the miniature were kept in perfect correspondence.

Daily the men came to study the miniature map, noting carefully the changes taking place in and behind the enemy's line. Officers lectured with regard to the details of the coming offensive, so that every Tommy knew precisely the ground over which he was to tread on the day of the big attack, and his primary object, his secondary object, and the ultimate object of attack.

When the supreme moment came, every British soldier engaged in it went about his work with a complete understanding of what was expected of him. There was no confusion. Difficult manuevers were executed with despatch. In short, every soldier worked with an intelligence that had been unknown.

But Messines Ridge is not the only instance of letting the soldier think for himself. The British have made it part of their military tactics, so have the French; and as likely as not the other armies are now doing the same. Rumor has it that the Germans are permitting their men to think; before an offensive every Fritz is instructed as to his part in the coming action. But somehow or other this way of doing things seems so foreign to the German military mind that it must fail to bring the results achieved by the British and French.

So the soldier is at last being encouraged to think for himself. Instead of receiving a command to do a certain thing just as you would pull the string of a mechanical toy and expect it to respond instantaneously, the soldier of the present receives that command but at the same time he is told just what it means to him and to other units of the army. He is thus able to carry out the command with a degree of intelligence heretofore lacking in military life. If—and in trench warfare and with modern barrages this is quite common—he is confronted with strange conditions not foreseen in his instructions, and if there is no officer at hand to give him an alternative or additional command, he is sufficiently informed to save himself and accomplish his task on his own initiative.

In no wise does all of this affect discipline, for above all an army must have discipline. But by letting the soldier use his brains much can be and much will be accomplished. As Major-General Charles M. Clement, U. S. A., recently said: "Victory will come in this war to the best-educated men. It is not the airplane, the submarine, the hand grenade or bomb that is going to win, but the brains of the soldier plus his confidence in his rifle and bayonet."

The Problem of the Unsinkable Ship

WE direct attention to the plans on another page of this issue, which show the methods adopted in a certain ship, the "Lucia," to enable her to receive the blow of a torpedo without being sent to the bottom.

Although this is the first time that the principle of utilizing a large number of watertight boxes has been reduced to a working basis and actually tried in a ship, the idea is not new; on many occasions during the past few years, the SCIENTIFIC AMERICAN has received suggestions covering this general principle, and particularly in 1912, after the tragic loss of the "Titanic."

It should be understood that the method as applied to the "Lucia" is entirely in the nature of emergency work—neither the Naval Consulting Board, under whose auspices the work has been done, nor Mr. Donnelly himself, would suggest that in peace times all merchant ships should be loaded up with wooden, metal-covered boxes in this way. The "Lucia" represents an attempt to meet a sudden and enormously serious crisis by hastily improvised means; and if she proves to be a success we are of the opinion that for certain types of ships that have to pass through the submarine zone—that is to say, relatively slow ships carrying particularly valuable cargoes—it would be a good policy to introduce this system.

On the other hand, if anti-torpedo construction is to be incorporated into any of the ships now under construction, it should be of the permanent type, and an adaptation of the principles followed on the ships of our Navy. An excellent plan would be to use ship frames and deck beams of extra depth at certain intervals along the length of the ship, and have the inner flanges of these carry an inner skin on the sides of the ship and a false deck on the under side of the deck beams. This, of course, would involve a certain loss of cargo space; but it would provide a ship that could take the blow of the torpedo and have a good fighting chance to get home and into dry dock, and remain on the lists as a serviceable ship for the remainder of the war.

The opposition to incorporating non-sinkable qualities in steamships comes entirely from the men who are in the shipping business to make all they can financially out of it. Just now, however, this matter of building a fleet of new ships is not one of personal profit but of national need; and the question of building non-sinkable ships should be viewed entirely from the standard of what is best for the winning of the war.

The Latest Guide to the Arctic

THE U. S. Hydrographic Office has recently issued, in its well-known series of sailing directions for all parts of the world, the first volume of an "Arctic Pilot," a work of about 360 pages. This volume professes to give in copious detail a description of the northern coasts and waters of Russia and Siberia, with the neighboring islands and the preface indicates that, besides being compiled from all available sources, it is corrected up to some time in 1917. When, however, the student of geography turns to this work for a handy resume of the revolutionary discoveries of recent years along the northern coast of Siberia he is grievously disappointed. Concerning the annual expeditions of Commander Vilkitskii, from 1910 to 1915, and their results, not a word is said. It is with something like stupefaction that one reads, in an official publication of the middle of the year 1917, a detailed description of the region about Cape Cheliuskin (for some mysterious reason called throughout the text "Cheluiskin,") with much information about the explorations of Nordenskjold and Nansen, and encounters no hint of the fact that in the year 1913 the Russians discovered just north of that cape a great new archipelago (Emperor Nicholas II. Land), the finding of which was the geographical sensation of the year; nor of the fact that in their journey of 1914-15 Vilkitskii and his companions accomplished for the first time in history, the feat of rounding this cape in an east to west direction and completing the Northeast Passage from Behring Sea to Europe. Yet every geographical journal in the world, and indeed almost every daily newspaper, has published accounts of these epoch-making journeys; while Nicholas II. Land is duly represented in the recent atlases of European publishers.

Another unsatisfactory feature of this Arctic guide is the meager attention it gives to the great developments that have recently taken place in the navigation of the Kara Sea route to Siberia. The notable achievements of Mr. Jonas Lied and his associates pass unnoticed, except for the statement that "in 1913 Dr. Nansen made an expedition in the steamship 'Correct' through the Kara Sea to the Yenesei River"—a curiously misleading record of the fact that Nansen traveled, as a passenger, on the first of the successful commercial voyages carried out under Lied's direction. Lastly, it is a pity the compiler did not make use of the elaborate and detailed account of the ice and other conditions of the Kara Sea route published by E. Lesshaft in *Annalen der Hydrographie* for 1914.

Naval and Military

Warship Repairs in War Time.—Over and above the great activity of the British yards in building new warships, particularly destroyers, and the construction of merchant ships, an enormous amount of time and labor has to be devoted to repairs. In a recent speech, Sir Eric Geddes said: "During one month, the number of war vessels which needed repairs was nearly 1,000—that is in addition to the 1,100 merchant ships—and that was by no means an abnormal month. Since the beginning of the war 31,000 war vessels, including patrol craft and mine-sweepers, have been docked or placed on the ways, and these figures do not include repair work done to the vessels of our Allies." Add to this the arming of the vast fleet of British merchant vessels and we have some conception of the enormous task of shipbuilding, equipping and repairing, carried on by the British Admiralty.

U-boats Have Murdered 14,120 Non-combatants.—There is a danger lest familiarity, even with such a monstrous crime as unrestricted U-boat warfare, should breed indifference to its enormity. Therefore, it is well to bear in mind that, except when the attack is made on fighting ships or transports carrying fighting men, the torpedoing of ships and sending men to their death far out at sea, is simply murder, unredeemed by any extenuating circumstances whatsoever. Just how great a bill of indictment is being drawn up by the German Admiralty against itself is seen in the statement given by the Government Leader in the House of Commons early last month, that up to February 5th, 1918, the German U-boats had killed 14,120 non-combatant British men, women and children. This be it noted, is exclusive of the murders done upon peoples of other nationalities.

Forty-foot Channel at Hell Gate.—The SCIENTIFIC AMERICAN is heartily in sympathy with Murray Hulbert, Dock Commissioner of this city, in his endeavor to secure a 40-foot rather than a 35-foot channel through Hell Gate. Forty feet is the standard depth for all channels liable to be used by the capital ships of the United States Navy. Thirty-five feet is a rather scant depth for our largest ships even in peace time; but in time of war, when such ships might have to make port in a damaged condition and drawing, therefore, many feet more water than their normal draft, 35 feet would be all too little. Strategically considered, the possession of two alternative routes for our battle fleet to the sea from the Brooklyn Navy Yard, one through the Ambrose Channel and the other by the East River, would be of the greatest advantage. We have 40 feet in the Ambrose Channel and the same depth ought to be available through the East River.

Building Destroyers at the Ford Plant.—Henry Ford recently stated to the writer that last year he was turning out cars at the rate of 3,000 per day; and in that fact is to be found justification for the belief that the Ford works are the most notable example in the world of quantity production on a large scale. The resources of this great industry are now being devoted to quantity production of anti-submarine craft. These vessels will be small destroyers—200 feet in length and displacing about 500 tons. They will embody the experience gained during the past year in hunting the U-boat in the submarine zone. Particular attention has been paid in their design to seaworthiness, so that they can remain at sea and on the job in all weathers, and be ready at any time to maintain full speed. Their armament will be powerful and fully equal to the heaviest carried by the larger U-boats. What they do not sink with the gun, they will have a good chance to get with the depth bomb. The first ship is well under way, and when the work is in full swing, the finished vessels will come off the ways in rapid succession.

The Greatest Shipbuilding Center.—Estimated on the basis of the amount of tonnage which has been contracted for, the Delaware Valley is being transformed into the world's greatest shipbuilding center. On the Delaware River between Trenton and Delaware City 11 shipbuilding plants have undertaken contracts for the construction of a total of 272 ships, including war vessels; and W. N. Ferguson, a representative of the Emergency Fleet Corporation, estimates that an army of about 85,000 ship workers will be required to complete these vessels. The great yard at Hog Island, just below Philadelphia, has contracted to build 120 cargo carriers. The work of building this yard has been an enormous task in itself, and the fact that the original contract price has been greatly exceeded is due largely to the fact that the work has been done during a winter of unprecedented severity. The keel of the first ship has been laid and from now on the work may be expected to go on at an accelerating speed. In spite of initial delays, the company which has this work in hand believes that it will get the ships out on time. In this connection, we may mention that the seventh keel of the 150 steel vessels which are to be built at the new yard at Port Newark, has been laid. The rate of progress at this yard is largely a question of steel deliveries.

Astronomy

Schaumasse's Comet (b 1917).—This comet will make a near approach to the earth on March 31st. Dr. Crommelin suggests that a lookout be kept for possible meteors associated with it on that date.

A Splendid Meteor was observed from several points in northern and central France on the night of July 4th, 1917, during the total eclipse of the moon of that date. Its brilliancy was equal to that of the moon in the first quarter, and it shed a greenish or bluish light over the landscape.

Minima of Variable Stars.—An important extension of the work of observing variable stars carried on under the auspices of a committee of the American Astronomical Society is the recent undertaking of the Goodsell, McCormick and Victoria observatories to secure observations of the minima of variables between the 12th and 16th magnitudes.

The Direction of the Sun's Axis has recently been redetermined by Th. Epstein on the basis of observations of 58 spots, in various latitudes, during the years 1903 to 1910. The results are published in *Astronomische Nachrichten* No. 4892. The value found for the longitude of the ascending node of the equator is 73 deg. 59.2 min., and for the inclination of the axis to the ecliptic, 82 deg. 43.7 min.; values differing very little from those of Carrington which form the basis of existing tables.

Mellish's Comet (a 1917), according to the last report of the Comet Section of the British Astronomical Association, was independently discovered in the southern hemisphere, to which no information concerning it had been cabled, as a brilliant object in the morning sky in mid-April. It had a curved tail, 20 degrees in length. It was the brightest comet which has appeared for some years. Computations by C. J. Merfield give it a period of 189 years. The period computed at Copenhagen was 142 years.

Phosphorescence on the Moon?—Several European observers of the total lunar eclipse of July 4-5, 1917, have reported that the brightness of the lunar disk appeared much greater around the limb than near the center. These observations lead M. A. Nodon of Bordeaux to revive a suggestion that has sometimes been made to account for the brilliancy of certain lunar craters; viz., that the surface of the moon may possess a luminosity of its own in the nature of phosphorescence. In that case, perspective would increase the apparent luminosity toward the limb.

The Fête of the Sun.—For many years it has been the custom of the Astronomical Society of France to hold a celebration on the Eiffel Tower on the night of the summer solstice. This custom has been in abeyance since the beginning of the war, as the tower has been given over entirely to military uses, but the "fête du soleil" will undoubtedly be revived as soon as conditions permit. Meanwhile the Astronomical Society of Spain and America has adopted a similar celebration of the summer solstice. It was duly carried out last June at the Fabra Observatory, in Barcelona.

The Public and Astronomy.—There can be no doubt that there is just now a great awakening of public interest in astronomy. Renewed evidence of this, if any were needed, is afforded by the secretary of the American Association of Variable Star Observers. About a year ago, at this gentleman's request, we carried in this column a brief note describing the aims and needs of the Association, and appealing for additions to its corps of volunteer observers all over the world. Within one month the secretary states that he had received 53 replies to this very modest little notice.

New Astronomical Blunders.—The French journal *L Astronomie* continues to furnish relaxation for the strenuous astronomer by publishing examples of popular ignorance on astronomical subjects. A surgeon in the French army, at the front, reports that some German artillerymen recently bombarded Venus, in the belief that they were firing at an enemy airplane, lighted up by the last rays of sunset. At Padua a crowd assembled in a public square to watch what they took to be an Austrian aeroplane—Venus again. They were reassured when a passerby, after inspecting the planet through opera-glasses, informed them that it was not an aeroplane, but the *North Star!*

An Enormous Solar Prominence, visible on May 26th, 1916, is discussed by Mr. J. Evershed in a recent bulletin of the Kodaikanal Observatory. This prominence reached the unprecedented height of half a million miles (nearly five-eighths the diameter of the sun), and in some parts attained a velocity of 284 miles a second. The whole prominence faded almost simultaneously; according to Mr. Evershed this would follow from the fact that the gas of which prominences are composed is so rare that it can have no real temperature; its emissive power depends only on absorption of photospheric radiation, and this is apparently insufficient to maintain luminosity at great heights.

Industrial Efficiency

Girls for Meter Readers.—In keeping with the policy of replacing men of draft age by girls in various forms of light work, at least one electric company has started employing girl meter readers and collectors. It is reported that the experiment has so far proved successful.

Cement for South America—A Case of Good Packing.—For once it is possible to compliment American packers! American cement deserves a high place on the honor roll of good export packing, according to the American Consular Agent at Santiago, Chile. During a tour of the west coast of South America hundreds of barrels of various brands of American cement were seen, and with comparatively few exceptions they were in excellent condition when they arrived.

Binding Machine for the Office.—For the fastening of paper, cardboard, silk, cotton, dress goods and the like, a simple form of binding machine has now been introduced for use in offices. This device takes a spool of special stitching wire of more than 1,250 feet in length, which will enable the machine to make and clinch over 15,000 staples before it becomes necessary to put in another spool. From two to forty sheets of paper, depending upon the stock, can be bound together without any adjustment of the machine.

Casualties in Our Battle with Carelessness.—Industrial accidents cost this country 35,000 human lives and many millions of dollars annually, according to the *Arizona State Safety News.* "In addition, dismemberments and other serious injuries total about 350,000 yearly, while the annual number of minor accidents, causing loss of time, exceeds 2,000,000. The putting forward of Safety is effected by well-known methods: First, you must have an organization that will handle the proposition; second, you have to put your plant and equipment into a proper and safe condition; third, you have to educate people as to the importance of their own responsibility to the Safety cause. To keep the ball rolling is the problem which confronts all Safety organizations."

Corrosion of Muntz Metal.—The Bureau of Standards, in Technologic Paper No. 103, entitled "Typical cases of the Deterioration of Muntz Metal (60:40 Brass) by Selective Corrosion," reports the study of selective corrosion of this material, which has a variety of industrial uses. The selective corrosion is illustrated by four types, including tubings, sheets and forgings. The metal becomes red in color, very weak, and brittle by this type of corrosion. The condition favorable to such corrosion is the accelerating effect of the closely adhering deposits of chloride resulting from the attack of the metal. Other conditions accelerate the corrosion such as contact with the more electronegative constituents, increase of temperature, and service stresses. This paper is now ready for distribution and those interested may obtain a copy by addressing a request to this Bureau.

Four Countries Buy Two-thirds of American Exports.—Considering the enormous values turned over every year in the world's international commerce it is extraordinary in what a few countries these values originate. Taking for instance the case of the United States, it appears that in the year 1913, 53 per cent of all the imports originated in six countries. These were the United Kingdom with $295,000,000, Germany with $186,000,000, France with $136,000,000, Cuba with $126,000,000, Brazil with $120,000,000 and Canada with $120,000,000. During the same year, four of these countries consumed 61 per cent of all the merchandise exported by the United States. The respective values were: United Kingdom $597,000,000, Canada $415,000,000, Germany $331,000,000 and France $146,000,000. In this connection it is worth noting that more than one-third of the total exports of the United States consist in six commodities only, the total export value of which is $950,000,000. These are cotton, copper, coal, lard, wheat and wheat flour.

The Motor Truck and the Transportation Problem.—A demonstration of the possibility of coöperation between motor trucks and boat lines for the improvement of transportation facilities has been given in the territory adjacent to Long Island Sound, according to reports that have been received by the Office of the Chief of Engineers of the War Department, and communicated to the Department of Commerce. At New Haven, Conn., products are being received from interior points in that State by auto trucks, which deliver goods at the dock of the Starin New Haven Line. Transportation is by water from that city to New York, and the following day the goods are loaded on a through car for their destination on the Lackawanna Fast Freight Lines. This new war-dispatch route eliminates the transfer car, and the use of car, engine, and floor space in freight house, and tends to consolidation and increased tonnage on the through car from New York to the destination. Among the places in Connecticut that are being put into direct communication with the Sound transportation facilities are Derby, Shelton, Ansonia, Seymour, Waterbury, New Britain, Meriden, Hartford, Middletown, and Wallingford.

The upper jaw of a whale before any of the whalebone has been removed

Dragging the partially cut up body of a whale out of the rising surf

The Whale as a Food Factor

Sea-Grown Meat That Compares Favorably With Beef

By C. H. Claudy

Photographs copyrighted by Underwood & Underwood

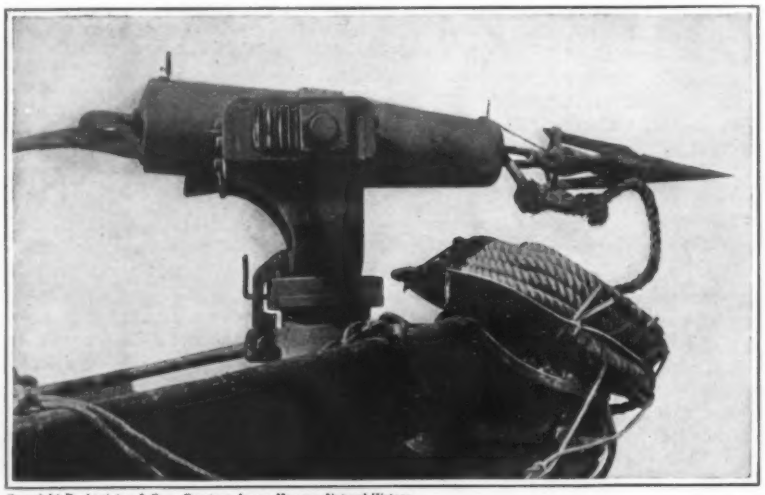
Whale Croquettes.—3 cups left-over cold roast whale, finely chopped; 1½ teaspoonfuls salt, trifle pepper; 3 tablespoonfuls melted butter; ½ teaspoonful savory (optional); 2 sprigs parsley, finely chopped; 1 large onion, finely chopped; 6 to 8 walnuts, finely chopped (optional); ½ cup dried bread crumbs.

Moisten with just sufficient gravy to hold meat together. Shape into croquettes. Egg and crumb in the same manner as the cutlets, and fry in deep fat for about 8 minutes. The fat should be sufficiently hot to brown a piece of white bread in 45 seconds. Serve at once, and garnish with parsley and sweet pickles.

NOTE.—The same mixture may be moistened with a beaten egg, formed into meat cakes, and fried in a pan; or made into Whale Hash, and served on points of toast.

THE above is not a joke! It is one of several tried and proven recipes for using whale meat. Yes "meat"—not "fish." The whale is a red-blooded, warm-blooded, sea-inhabiting animal, not a fish.

Until very recently the whale was of commercial value only for the oil from its blubber, and the fertilizer which could be made of its flesh, viscera and bones. Today whales are not only killed for their fat and oil, but are proving of economic value as food and by no means as an experiment. Suggested as a food by the Bureau of Fisheries in May, 1917, last year nearly a thousand whales were killed near the Pacific coast and made to yield not only their normal product of oil and fertilizer but an average of nearly eight tons of flesh for food for human beings. This is equivalent to the flesh, in quantity at least which would be obtained from a herd of about 25,000 cattle—no mean contribution to a meat market in which the supply is so much below the demand. The flesh of almost all the whales, with the exception of the bottle-nosed whale, is not only edible but enjoyable. The bottle nosed whale has an oily taste to his flesh, and worse, this oil taste comes from an oil in the flesh the action of which is somewhat similar to castor oil. So the bottle-nosed whale is no source of food! The other whales, however, yield flesh which tastes so much like good beef that it is difficult to tell the difference by anything save the fact that whale meat is coarser in fiber and darker in color than beef. This coarseness, however, is not accompanied by toughness—whale meat, properly prepared, is as tender as good beef, and when put on the table without a label is usually mistaken for beef, or, sometimes young pig.



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Whale-gun and harpoon set for action

The public associates blubber and oil with the idea of whale. The association is natural, but unjust to the food. What is eaten is the muscular fiber of the whale, which is found beneath the heavy oily skin and the blanket of blubber or fat which is "tried out" for its oil. This muscular fiber is not solid, but contains a sufficient amount of fat to make it a well balanced meat ration and this intra-muscular fat is of a fine white flaky texture, without any of the oiliness which distinguishes the blubber.

So far, comparatively little whale meat has found its way eastward, although it has appeared from time to time in some New York hotels, where it has been more of a curiosity than a regular staple of diet. In cans, however, it is making its way from the coast east, and as it cans readily and keeps as well as or better than beef, it seems destined to play a not unimportant if minor part in the world's menu.

Performing a major operation on the jaw of a whale

Dismantled carcass of a whale caught on the Long Island coast

The supply is on the increase. The shore whaleries of the Pacific Coast were not prepared to realize on the meat as meat when the demand was made upon them. After trying out the blubber for oil, the rest of the carcass was turned into fertilizer at perhaps two cents a pound. Whale meat at ten cents a pound represented so tempting a buy to the housekeeper and so unexpected a profit to the whale killer, that the demand has been met as fast as the necessary plants could be erected. The price has been as high as 22½ cents a pound in San Francisco which, though perhaps high, is cheaper than beef, particularly when it is considered that there is little if any waste in whale meat. When a whale is towed to shore, now, the blubber is removed to get at the meat, and that is "harvested" first, either for direct shipment to market, or for putting into the recently erected cold storage plants, or for the cannery.

It seems not unlikely that the meat, hitherto a by-product, will shortly become the principal yield of the whaling industry with blubber and oil the by-product, although the skin and parts of the viscera are showing astonishing possibilities, of which more in a moment. A forty or fifty-ton whale will yield from ten to fifteen tons of meat and from six to eight tons is an average yield from the average whale. Inasmuch as the meat is all together and not scattered among many carcasses, as with beef, and as the killing takes place in the ocean, and there are no expenses of slaughter houses, railroad transportation and similar factors in ordinary packing, the price of whale meat should always remain considerably below that of good beef.

By no means all the meat of one whale is of one grade, nor are all whales similar in the yield of meat as to tenderness. The matter is as yet too new to have arrived at any very accurate knowledge of the most tender cuts of whale, or of the best kind of whale from which to get a steak or roast. Incidentally, if there is no known means of feeding whale stock to produce "fancy beef" neither is there any expense on "pasturing" whales which will probably continue to feed themselves and be available as food as long as the supply lasts.

Undoubtedly this time is limited—perhaps not by any definite number of years, but as unquestioned by authority as the (all but) extinction of the buffalo and the practical extinction of the right whale and bow-whale today. Should international laws be enacted looking to the conservation of this economic asset, the threatened extinction may be averted, but whether or not the pressing political questions growing out of the great conflict will leave time for whale fishing regulatory laws seems problematical.

However, the whale will supply good food in rapidly increasing quantities while he lasts. Perhaps almost equally important is the fact that the whale's skin, his stomach and his intestines have developed an entirely new source of a high grade of leather.

Before the shortage of leather made any possible source a matter of serious import, whale skin was considered too oily to tan. Now, it has been discovered that by putting the skin through a wringer and squeezing out the free oil, the skin can be tanned to a thick, tough leather of fine grain and with the peculiar quality of stretching sidewise but not lengthwise. The skin of a whale, which frequently shows folds on the belly, is loose in a lateral direction either to accommodate his body to variations of pressure or to expand as he swells with a hearty meal. This quality remains in the finished leather. Whether it will be an asset or not depends on the uses to which whale leather is put.

There seems to be no doubt that the yield of 3,000 square feet of good leather will add considerably to a whale's value, however, and this is without taking into account the fact that his intestines yield 300 square feet of a fine white leather closely approaching kid in texture, and of a toughness much greater than kid. The stomach yields a similar leather of even greater toughness—so strong that a strong man cannot tear it by trying to pull it apart, whereas a kid skin is easily torn by the same exertion.

Altogether, it seems that the whale has been a somewhat neglected source of human wealth and comfort, and that the animal which has previously done little but supply oil, fertilizer, and romance for writers of sea stories, has been, all along, a source of food and leather, the value of which far transcends its other wealth.

The fin of a whale caught off the Long Island coast. It is nine feet eleven inches long

Bombing and Getting Bombed

THE day of the bombing plane is here. It has been long coming and more than once we may have considered the pre-war writings of many a novelist, picturing frightful air raids with their accompanying toll in lives and property, as far-fetched; but every indication points to the extensive employment of the bombing plane this year. Both sides are going to bomb railroads and factories and towns and camps far in the enemy country. This, we are told by men in a position to know, is going to be a war behind the lines, with the attackers winging their way high above the intrenched lines and massed guns.

A 220 mm. shell with tail fins for bombing purposes, being prepared for a German target

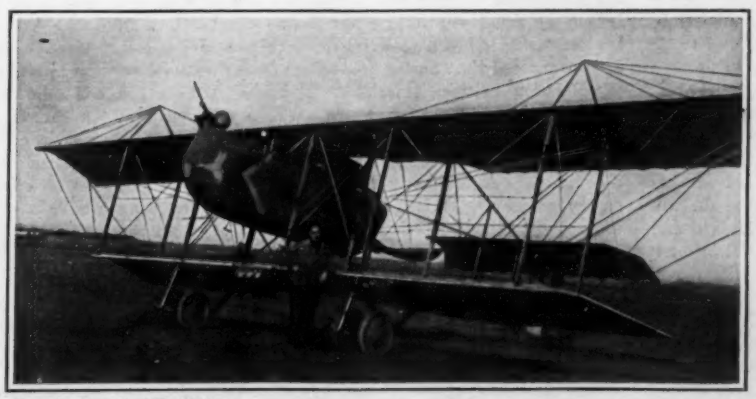
How effective is aerial bombing? That is a question which is difficult to answer. The bombs used early in this war were small and therefore of very limited destructive power. Sighting was still crude. But with the present bombs weighing anywhere from 50 to 400 pounds the destructive power of these missiles has been increased many fold. It is said of the latest German bombs that their destructive power is tremendous; for the time being they hold first place. As things go in aeronautics, however, this superiority is temporary. Already our French allies are at work on a bomb far more frightful in its effects.

British and German bombing is generally carried out with large machines. The former are now making use of large Handley-Page biplanes, while the latter are using fleets of Gotha biplanes. Either of these twin-engine types can carry upwards of a dozen large bombs, and are ideal for this class of work. On the other hand the French air service, although capable of building large machines and, indeed, possessing several excellent twin-engined types, for some reason or other prefer to continue using comparatively small Farman pusher biplanes, each capable of carrying several small bombs or one large torpedo.

Germany, that exponent of ruthless warfare and frightfulness, has thus far confined her bombing activities to enemy cities, such as London, Dunkirk, Dover, Nancy and other centers of population in France and England. Hers has been a campaign against civilians, with not a shred of legitimate excuse on the grounds of military necessity. The Entente air fleets, on the other hand, have conducted a vigorous air campaign against German works, camps and railroads, with an occasional raid over a German city as a reprisal for German air attacks on civilians.

Just how effective legitimate air raiding is may be judged by one case. It is said on good authority that certain French bombing squadrons, attacking night after night, weather conditions permitting, have reduced the iron production in the Briey region by at least 50 per cent. The Germans occupying that district are so hampered in their work by the nocturnal raiders that there exists a state of semi-disorganization. The Krupp works on at least one occasion has suffered some loss, but nothing can be learned definitely until after the war—and perhaps not even then. But it is known that numerous German railroads have been hampered by air raids, especially at times when it proved mighty inconvenient to frenzied commanders endeavoring to rush up troops and artillery to some hard pressed section of the line.

It remains for 1918, however, to witness the greatest aerial bombing activities. Both sides are going to send vast fleets into the enemy country. Civilians are going to suffer as never before—if adequate protection is not provided. In the case of the Allied countries it is to be hoped that defensive squadrons will be available in sufficient numbers to discourage the wholesale bombing of positions back of the line. For the side that can ward off enemy bombers while in turn sending its own bombing fleets far into hostile skies, is going to have a telling advantage in the year's campaigns.



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Farman pusher biplane of 170 horsepower. This machine is typical of the French bombing service

The Soap-Nut Tree

MR. E. MOULIÉ, of San Diego, Cal., the father of the soap-nut tree (*Sapindus Muskorossi*), in the United States, will this spring conduct another distribution of the seed of this interesting tree.

In our issue of March 1911 we gave considerable space to setting forth the qualifications of the soap-nut tree. Briefly to restate these, the nut is not only good to eat, but contains an incredible amount of fat and soap-making materials, the former in the kernel, the latter in the shell. We recall that in 1911 we used the nuts furnished us by Mr. Moulié, to wash the editorial hands for a week or so, and then cracked them and ate the kernels with no less relish.

The tree is 50 feet tall when fully developed, quite ornamental, with timber resembling orangewood. It bears nuts when six years old. The nut value is $10 to $20 per tree for the average crop of 200 pounds. The nut has valuable medicinal properties, and the leaves are a splendid fodder. The hull contains the detergent principle, saponin. This by itself is a soap equal to any that human skill can devise, according to the claims of Mr. Moulié. On the basis of its oil and its general food value the kernel surpasses in value the peanut. Industrially and commercially the soap-nut forms the raw material for an immense variety of finished products. It costs practically nothing for the growing and harvesting. Today there are perhaps a million of the trees in the United States, mostly in Florida and California.

Mr. Moulié will fill orders for seed nuts at one cent per ounce to cover postage, plus 5 cents with each order to defray the cost of packing, etc.

Strategic Moves of the War, February 27th, 1918

By Our Military Expert

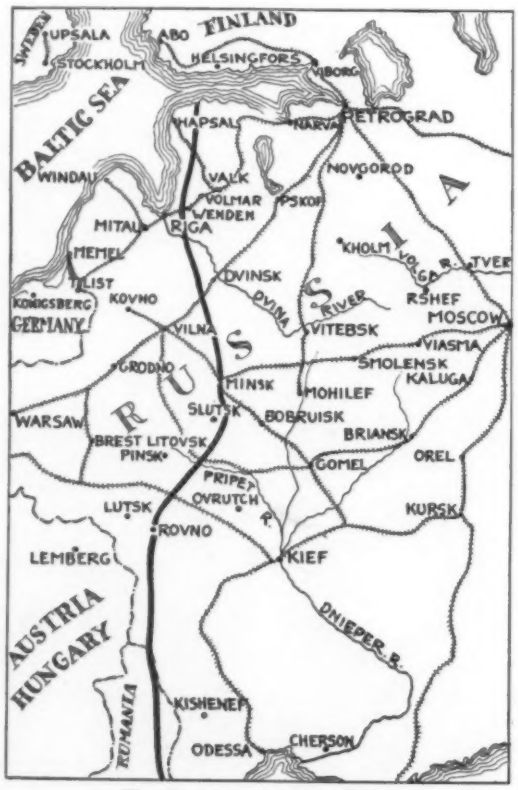
WHEN Russia—or rather the Bolshevik oligarchy representing such Russian government as exists—formally withdrew from the war recently, it was supposed that the east front had vanished from the war maps and from consideration as a factor of importance in the future conduct of hostilities. Especially when the treaties of peace were signed between the Central Powers and the Ukraine, the entire eastern line 750 miles in length, extending from the Baltic to the Black Sea, was presumed to have passed out of existence. It was these circumstances that have led to so many discussions in the press regarding the number of troops the Central Allies could send to reinforce their armies in France and Italy in time for the long-talked-of spring drives to be begun. But it now appears that every one has been reckoning on very unknown quantities, the latest news indicating new developments of supreme importance, since the Germans began a few days ago an extended advance toward the east in Russia.

This drive continues much like a military parade and entirely unchecked. The German forces are moving forward over a front from the Gulf of Finland to the borders of Galicia, a distance of four hundred or more miles. German warships are reported as approaching Reval, the great Russian naval base on the Gulf guarding the approaches to Petrograd; this city is about two hundred miles from the capital. As Helsingfors, the other defensive fortress on the north shore of the Gulf, is now in the hands of the Finnish troops, Kronstadt near Petrograd is the only remaining naval defense for the city. Esthonia, Livonia, and Courland are rapidly falling without resistance and enormous quantities of supplies of every kind, guns, motor cars, and railway transport are being accumulated. Everywhere the German cavalry are moving rapidly to the east seizing important highway and railroad junctions. The great Russian triangle of fortresses in Volhynia, Lutsk-Dubno-Rovno, are now entirely in German hands for the first time since hostilities began in 1914. On long stretches of the front Russian troops are leaving the trenches, going to the rear or returning directly home. Even officers are deserting the army, hundreds having already left their troops and regiments. The numbers of runaways, both officers and men, are given as increasing day by day, leaving little hope of any serious resistance being offered to the German advance for some time to come. It is evident that, in resuming military activities, Germany's future policy will include at least the Russian Baltic provinces in a scheme of incorporation into the German Empire, and will also have in view the greatest possible extension of its authority to the east. The anarchistic policy of the Bolshevik is now bearing its fruit for the utter ruin of Russia as a state appears imminent.

No living man can today hazard a guess at what the map will be that will finally portray what once was Russia. Newspapers speak of civil war prevailing there; but what is now occurring is the building up of old and new nations, something that has so often been repeated in the history of the world when such an empire as that of Russia has gone to pieces. It is all simply the emergence of new nations from the wreck and ruin of what has outgrown its usefulness and must be thrown aside. In the east of Europe Russia once conquered the smaller independent nations but never really assimilated them. The fall of the Romanoffs released them and they are again rising and being restored. Whether the Ukraine will also be the scene of new struggles remains to be seen, since Austria, recognizing the physical aid in food and supplies of every kind that it is possible to obtain from that country, is very loath to stir up further strife so close to her borders and thus add to her own troubles, which have now about reached a climax of suffering and of privation for her sorely tried population. It would certainly appear that a waiting policy would be for her the best one; for Russia is in a state of chaos and there is every indication that her whole economic structure, including all her industries, railway systems, and trade measures, has utterly broken down, and on so great a scale that the world at large cannot realize what is happening throughout the vast empire once ruled by the Czar. It would certainly be good policy for Austria to "stand from under" as the crashes come and to pick up the plums that will most certainly drop into her waiting hands. All Austrian news reports indicate that she will consider the Austro-Russian armistice as unchanged and will do everything possible to enable the Ukranian government to establish and maintain order in its newly formed realm.

That portion of the eastern front now held by the Rumanian troops is an exception to the general truce heretofore declared; but isolated as Rumania is, her general attitude can have but little influence, even should she prefer to continue on the basis of enemy of the Central Powers. The richest and most prosperous portions of her territory have been occupied by her opponents while a good part of her population fled from Wallachia to Moldavia at the time of the Austro-German invasion and they have since suffered great want and many hardships. The latest information states, however, that her army is still a fighting force to be reckoned with and that it is in an excellent state of discipline. The country as a whole is placed in a very equivocal and dangerous position, as it must hold back the Austro-Germans on the west and Russian disorder and anarchy on the east.

Practically, at present, as regards fighting lines, there is but one front—that on the west extending from the North Sea to Switzerland and from Switzerland to Eastern Italy and the Adriatic. Since Russia's collapse the great question has been how far the recent occurrences in the east would permit the reinforcing and strengthening of the German and Austrian lines on this front by withdrawals from the Russian front; for the recent advances into Russia of the Germans show the need there of large bodies of troops that will be fully occupied for some time to come. It must be remembered too that the men of both the German and Austrian armies there are composed largely of poor material since the younger and more vigorous components have been removed to bolster up and strengthen the weakened divisions in the west. The eastern front has been used as a theater of war where worn out divisions and where men in general could be sent to recuperate and to regain their strength The general withdrawal under any



The German sweep into Russia

circumstances from the east to the other lines cannot, therefore, be made total by any means; for both Germany and Austria will use, for an indefinite time, troops in the east for garrison and police purposes. It is supposed of course that Turkey and Bulgaria will now withdraw their divisions and bring them back south of the Danube.

Authorities all make widely different estimates as to the number of German troops that are now or soon will be concentrated on the western lines, should German leaders decide to begin an active offensive as spring opens. It is computed that on the front lines facing in the west the Belgian, British, American and French troops, the Germans have now 112 divisions with 63 divisions held as immediate reserves. On a basis of 12,000 men to a division, this would mean 2,100,000 immediately available troops. As Germany had on the eastern lines about eighty divisions, it is probably that not more than forty divisions have been or can be transferred to the west. This would mean an additional 500,000 or a grand total of 2,600,000 in all. It is certain that new concentrations are being constantly made behind the German lines and that a formidable system of defence on the front line positions has been built up since the cessation of fighting last autumn. But the number of men mentioned above would by no means give the Germans a superiority of numbers since the French have on the various fronts 3,000,000 men of whom 2,000,000 are in France; the English are believed to have more than one and a half million in France alone and troops of other nations, including our own, would increase that number to at least two millions. The Allied forces are much better equipped and supplied than are those of their opponents and are animated by a spirit of optimism that it is believed their adversaries do not possess.

Despite predictions to the contrary, everything points to a successful resistance on the entire front if the Germans attack; if one or more forward thrusts are made by the Entente Allies, there is every prospect of successful and substantial gains. They have now a preponderance of men and guns on this western front and, when opportunity offers, they will certainly make use of their advantages. The winter months have not been wasted and every possible preparation has been made either for a forward movement or to resist a German drive or drives at any point where the enemy may elect to make his much advertised effort.

So far nothing has been heard of any forward movement of the Allies, but all accounts dwell upon an approaching powerful German offensive to be begun against the Allied lines in France; if such be the case, the open announcement of such a fact differs from German custom heretofore. Publicity has not been one of the German methods of "playing the game" in this war. As a fact, the favorable weather recently has offered every opportunity for opening the battle if that is what the German commanders desire, but only trench raids and "nibbling" to gather information have been the developments so far. In preceding years some of the hardest fighting had begun before this time and important gains had been made. But in the most favorable positions, as in those of the higher ground around Cambrai, nothing has so far happened except artillery duels and a few minor contests.

It is probable that the results of the battle of the Marne, of the check at Verdun, of the Somme offensive and of other struggles where the advantages lay always with the Allies have destroyed any illusions the Germans may have had as to the invincibility of their arms and have rendered them doubly cautious as regards attacking in the west where they know to their cost the military powers of the Entente Allies. So far, at any rate, Germany has carefully concealed her objective in her coming offensive. It is the belief of most military authorities that she would strike toward Calais, where it is possible she believes her opponents' lines to be most vulnerable. The greatest advantage she could obtain from an offensive would be the capture of the coast of the English Channel, for Great Britain considers the defence of this coast most vital to her own protection and would spare no effort to defeat an enemy threatening it. If Germany should succeed here, she would have to count upon enormous losses and most determined efforts to hold all gains. If, however, she could capture Dunkirk and Calais, it would be a terrible blow to the plans and prospects of the Entente Allies, practically cutting them in two in the west.

It may be possible that it is intended to strike in Italy, where both the political and military game can be played with some chances for a successful issue. It will be recalled that the Central Allies last year drove the Italian armies from the Carso and Isonzo fronts to the Piave and Brenta Rivers and that in the mountainous regions they fought their way to within a few miles of Bassano and the Venetian plains. They must therefore be given credit not only for strategic and tactical results but also for remarkable displays of courage and heroism. Snowstorms and unfavorable weather conditions did as much to bring the winter campaign to an end as the wonderful resistance of what was only a short time before a disorganized and beaten Italian army. That this campaign in Italy has been brought to a definite close cannot be believed. No doubt fresh divisions and guns are being brought up for a new push toward the plains and Venice. An offensive here where so much has already been gained by their own troops would be popular in Austria; and this is important if Austrian interest is to be kept up. The Germans cannot afford to abandon a campaign where so much is at stake and where so many political advantages can be gained at home. It is a safe conclusion that, for a time at least, a pretense at an offensive in France and a vigorous drive in Italy offer a great opportunity that no doubt has already received consideration by the German commanders. But the known weakness of Austrian morale and the unreliability of the Austrian troops in general have always made and are now making for Germany burdens that under present conditions are hard to struggle against. As a whole, it cannot be said that in this war the Austrians have been of very great material help since, on nearly all fields, it has been necessary for the Germans from time to time to come to their assistance and extract them from their difficulties.

An Additional Lifting Force for Airplanes

By Carl Hering

THE lifting force in the usual airplane of today is that due to a plane inclined slightly to the direction of motion, and forced forward by the propeller. It acts in a vertical direction according to the same principle that the rudder of a ship acts in a horizontal one. The lifting force is due partly to the compression of the air below the inclined plane, and partly to the suction of the rarefied air above it. Both of these forces act only when the plane is in motion, hence are zero when it is at rest and are very small when the airplane is starting from the ground or the sea.

In the helicopter principle the propeller moves in a horizontal plane and lifts by direct propeller action; but this has not come into general use, and it is said to require about six times the power to lift in this way as by means of the forward-moving inclined plane.

There is a third and quite different kind of lifting force which is available in all the propeller-driven airplanes of today, but which is not now used. It would require but slight changes in the present construction to make use of it, and as it seems to consume no additional power, it is of the nature of a gift; it is there to be used but is not at present being made use of; its use has been overlooked or neglected. It is of special interest as it is greatest when the airplane is at rest and therefore just when the usual lifting force is least, hence at the very time when any addition to the lifting force, even though small, is very important. One of the serious drawbacks in the use of modern airplanes is that when they start from the ground a comparatively large area free from obstructions is required for getting up sufficient speed, while on the ground, to produce enough lifting force to raise the airplane up high enough to clear the trees, telegraph poles, buildings, etc.

The principle of this new lifting force is best illustrated by some well-known experiments. Referring to Fig. 1, let *N* be a nozzle through which a stream of air is issuing in an upwardly inclined direction. When a ball *B* is placed just below this stream a short distance from the nozzle, it will be found to remain suspended; the ball may be said to be hung on to the bottom of the air stream considered as a sort of a beam.

A possible explanation of this peculiar phenomenon is that the stream of air causes a partial vacuum above the ball and that the ball is therefore supported by the air pressure from underneath. If this is the correct explanation, the theoretical maximum lifting force which could be produced in this way would be atmospheric pressure, namely a little more than one short ton per square foot, a maximum which of course could never be expected to be nearly reached, but a very tempting one to approach as closely as possible; obtaining only as little as one per cent of this would still be 20 pounds per square foot, which is very large compared with the present lifting and sustaining force which is said to be about four to six pounds per square foot and this only at high speeds, it being zero when the plane first starts. If this explanation of the phenomenon is correct, the experiment of suspending a ball from a stream ought not to operate in vacuum, in which case a stream of some other fluid than air would of course have to be used, one with a low vapor pressure, like mercury for instance. It is not known to the writer whether this has been tried.

Another form of this force is illustrated in the well-known experiment shown in Fig. 2 in which a horizontal card *C* has a hole *H* cut into it; by blowing horizontally over this hole a card *C* placed below it will be held up by the air stream. In the usual form of atomizers it is this same force that lifts the liquid in the vertical tube, the horizontal air stream creating a partial vacuum above that tube. A sheet of paper held under the air stream from an electric fan, will be supported horizontally by this same force. A very strong wind blowing over a tin-covered roof, will sometimes tear off the sheet metal due to this same force.

Another form of this phenomenon is illustrated in the well-known experiment shown in Fig. 3. A disk *D* is secured to the end of a tube *T*, like a large flange. A second disk *d* with a pin *P* merely to keep it centered with the tube, is held beneath the first disk *D*. On blowing down through this tube the second disk *d* will be found to be held up, notwithstanding that the stream of air pushes it down in addition to gravity. The stream of air spreads out between the two parallel disks, and if the above explanation is correct, it tends to create a vacuum above and below it which forces the disks together; it should not operate in a vacuum. It is not true, as has been claimed, that the two disks must be of the same size; the lower one may be larger or smaller than the other.

With such disks four inches in diameter, a ¼-inch bore tube, and by weighting the lower disk until it could barely be held up by blowing through the tube with the mouth, the writer obtained a sustaining pressure of about a third of a pound per square foot. The actual sustaining force must have been still greater, as it had to react against the direct impact of the air stream through the tube. In a similar case, reported to the writer, in which this pressure was not wanted, and in which high air pressure was used and the two disks were held securely in place, this pressure became great enough to wrench the upper disk from the tube to which it was secured by graphite set screws; this shows the force to be quite great.

This experiment, however, is not an exact parallel one to the intended application of this force to airplanes, as the force sustaining the lower disk is in part reacted by a downward force on the upper side of the upper disk; the tube and its disk would no doubt weigh more when the lower disk was being held up by it. Applied correctly to airplanes there should be a plane below the stream but none directly above it.

In the modern biplanes, however, in which the stream of air behind the propeller generally passes between the upper and lower planes, the phenomenon is similar to that in this experiment and no doubt an upward force of this kind exists on that part of the lower plane which is below the air stream, but a nearly equal downward force would probably be found to exist on the corresponding part of the upper plane, hence there would be little or no gain. It is quite likely that if the canvas were cut away in that part of the upper plane which is above the air stream, the upward force on the lower plane would be a net gain, at least when starting from rest. If so, it would be a curious case of increasing the lifting force by cutting away some parts of the present planes. But this would depend greatly on whether the shape and location of the lower plane is the most appropriate one.

To make this new force available in an airplane it is necessary to hang the weight onto the bottom of the air stream, as though the latter were a sort of beam. This is done by adding a suitably shaped plane just below the air stream and secured to the framework of the airplane. This beam will be deflected downward by this weight, but this kind of a beam, depending for its stiffness on the inertia of the moving air, has the peculiar property that the force of a weight suspended from it will not be transferred back to the origin or support of the beam, namely the propeller, notwithstanding the contrary opinion of those who claimed it was a case of "lifting yourself up on your boot straps." When a projectile fired from a gun strikes an inclined surface and is deflected, the side thrust deflecting it does not react on the gun.

As this point was raised by several physicists, the writer made the experiment shown in Fig. 4. *B* is a rubber bag containing compressed air. When the valve *V* is opened the air is discharged through the two diametrically opposite nozzles *NN* which are exactly in line with each other. The curved planes *PP* were secured below these nozzles so as to be just below the air streams. The whole was suspended so as to be free to move in any direction. When the valve was opened, the whole apparatus moved up. When the planes were put above the streams, it moved down. When one was placed to the right and the other to the left of the stream, the whole apparatus revolved. This showed conclusively that there was no equal and opposite reacting force on the nozzle.

In principle, this method as applied to airplanes may be said to be lifting it by creating a partial vacuum above it, but in such a way that the corresponding downward force on this vacuum is sustained by the moving stream of air acting as a beam which is not sup-

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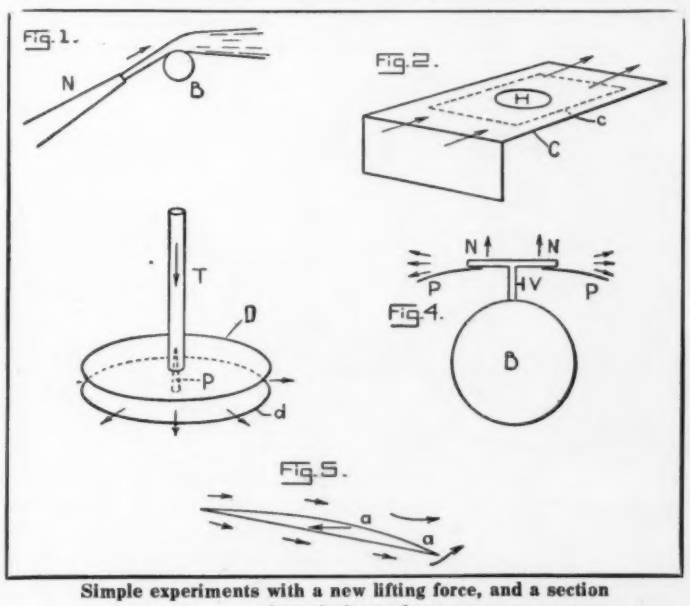

Simple experiments with a new lifting force, and a section of an airplane wing

Can Coal Be Pumped?

By Charles Evan Fowler, M. Am. Soc. C. E.

HOWEVER much we as Americans pride ourselves upon knowing the last word in economy and efficiency, the fact remains that the exigencies of war are forcing us for the first time to "get right down to our knitting."

The ideal power for all purposes is electricity, generated by hydro-electric power plants; next to this we can safely place the generation of electricity by steam plants located at the coal mines, with transmission lines to the point of consumption; after this the production of gas at the mines and its piping to the consumer; and lastly we have the production of power at the point of consumption from coal or oil transported from the mine or well to the distant power station.

The man who would suggest doing away with pipe lines for transporting oil would be deemed a poor economist or engineer. We know that pumping oil through pipes is vastly cheaper than any other method of transportation and we may cite as a recent example the 170-mile line between the Coalinga Oil Field in California and tidewater at Martinez on San Francisco Bay. This line has 11 pumping stations 15 miles apart, with one-third of each section of 10-inch steel pipe and two-thirds eight-inch steel pipe. The method used is the "hot oil process," the oil being heated to from 110 to 140 degrees Fahrenheit to make it more fluid, which method has been found best for California oils of about sixteen degrees Baume gravity. The oil is forced through the pipes at 800 pounds pressure, by four-plunger pumps operated by compound engines, the steam being generated in oil-fired boilers; the delivery being at the rate of about 25,000 barrels per day.

Elsewhere we find oil being pumped through pipes by the rifled process, where a thin film of water is injected between the oil and the rifled pipe to reduce friction, this method being exactly analagous to the pumping of powdered coal mixed with water. The two most economical methods of firing boilers are by the spraying of fuel oil into the fire box or of blooming in powdered coal, both methods being cheap in point of operating cost and high in heat units produced from a given amount of fuel.

The pumping of coal from the mines was the basis of Patent No. 449102 issued March 31st, 1891, to the late W. C. Andrews, one time president of the New York Steam Heating Company. There is an immense amount of slack coal or culm produced annually and the cost of coal mining could be materially reduced if no endeavor had to be made to produce lump and smaller sizes of marketable coal. For pumping, all the coal would be reduced to dust at a cost of less than three cents per ton, and freed from sulfur, pyrites and slate at about the same cost, and in the process of pumping it would be still further purified. It was proposed to have pumping stations located about thirty miles apart and with a pressure of 1,200 pounds per square inch to deliver about 6,000 tons per day through a 12-inch pipe or 30,000 tons through a 24-inch pipe, the coal being mixed with 50 per cent of water to form a thick soup. This would be exactly similar to the use of a thin film of water in pumping oil, except that the very low specific gravity of coal would make it easy to pump, anthracite coal having a specific gravity of 1.8 or less and 1.5 or less for bituminous grades, while materials pumped in hydraulic dredging have specific gravities of from 1.6 for moist earth and 1.9 for clay, up to 2.7 for sandstone and 3.1 for granite boulders.

The powdered coal upon delivery at the point of consumption would be separated from the water in settling basins or centrifugal dryers could be employed to extract most of the water, before actually drying it for firing through a nozzle burner. The burning of damp coal, however, would only cause a loss in heat value of less than 8½ per cent for good grades. However, the burning of powdered coal would give an efficiency of about double that attained by hand firing and 50 per cent greater than when mechanical stokers are used. The use of powdered coal was first employed at Woolwich Arsenal in England in 1873, and while it has been employed since in many special cases, it is only just beginning to be used commercially and a great power plant in the Pacific northwest is now being changed to use this class of fuel. The burners cause the powdered coal to be held in suspension in the furnace until full combustion takes place, so that it burns with practically no smoke and there is only about one-third the amount of ash. Besides reducing the cost of firing, similar to oil firing, the wear and tear on internal-fired boilers is greatly decreased.

The question of pumping coal for as short a distance as across the Hudson River would be a somewhat simple problem as pipe lines of the submerged type could be

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Camel team taking on stores at the rail head

The old and new compete in hauling supplies

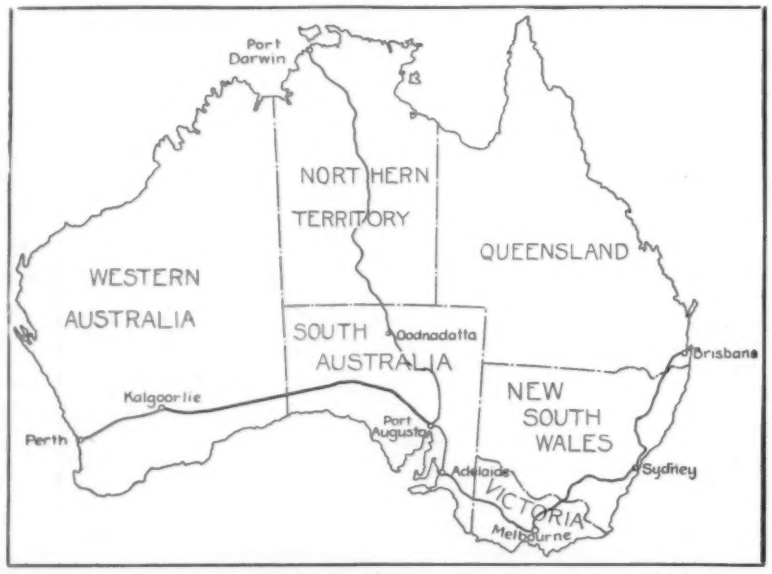
Australia's First Transcontinental Railroad

Camels a Leading Feature of Engineering Triumph Over a Thousand Miles of Desert

THE recent completion of the "desert" railroad, thus forging the closing link in Australia's first transcontinental track, may rightly be ranked as one of the most remarkable engineering feats carried out in the Southern Continent. The steel rails which were being pushed westward from Port Augusta, in South Australia, and eastward from Kalgoorlie, in Western Australia, have now met in the desert, and Australia's great dream of a transcontinental railroad is an accomplished fact. It has meant a five years' battle against terrible odds for there was a 1,000-mile desert to cross, devoid of any water supply and vegetation, devoid of everything except a scorching heat.

Were it not for the war we should have heard a great deal about this remarkable undertaking, for it was proposed that King George, or at least some member of the British Royal Family, should open the line when ready. The completion of the railroad has been delayed as a result of the European struggle, for it was to have been finished in 1915. When war broke out, over three thousand men were working upon it, but the staff was gradually reduced, as engineers and mechanics were called away to make shells, guns and equipment for the Australian forces, while there has been delay in securing rails, locomotives, pipes, and other necessary material.

It was the late Lord Kitchener who suggested the idea of building this line across Australia's most formidable desert. When he was asked by the Federal Government to draw up plans for the defense of Australia, he at once pointed out the need of linking up the various States of the Commonwealth by means of an iron road. This has been done, and it is now possible to travel by rail right across the island continent, from east to west, a distance of nearly four thousand miles.



The new line (heavy), showing its relation to the existing system, and to the projected north and south route across the continent

Before the coming of the railroad, Western Australia was cut off from the other States of the Commonwealth by the great Victoria Desert, a barren, inhospitable and waterless stretch of country, over a thousand miles square, across which no man or beast ever ventured, for it spelled death. Not a habitation of any kind or a single stream or rivulet is to be found in the whole of this vast region. It is one dreary expanse of sand and limestone rock, relieved here and there by scrub, consisting for the most part of saltbush, which even cattle refuse to eat. Worse still are the intense heat and the blood-sucking insects. Under the fierce heat the finger-nails split and the flesh, unless protected, soon blisters. The rocks and ground become so hot that it is impossible to touch them with the bare flesh. Any man or beast venturing into the region is at once attacked by hosts of flies and insects. Eyre, who was the first explorer to cross the desert, which he did in 1840, records how he counted 20 different kinds of blood-sucking insects, each leaving an irritating aching sting on four inches of his flesh at one time.

Many declared the feat of building a railroad across so extensive and arid a waste to be impossible, but it is now an accomplished fact, thanks to the splendid organization of the contractors and the grit and perseverence of the engineers. The mapping out of the route was no light task. Being a Government venture, the leading engineers and surveyors of the Commonwealth were called upon to carry it out. They divided their force into two, one working eastward from Kalgoorlie, and the other westward from Port Augusta.

For the Western Australian party 91 camels were requisitioned, this animal being selected because of its adaptability to desert traveling and ability to go for long periods without water. Thirty-six of these animals were deputed to haul three wagons; a like number were subdivided into three strings of pack animals; three carried stakes for locating the line; the balance were used for various other purposes. An important task was the distribution of stores to the extent of eight tons along the route for the survey party, together with ample supplies of water for both man and beast, the water stations being spaced at intervals of seven miles.

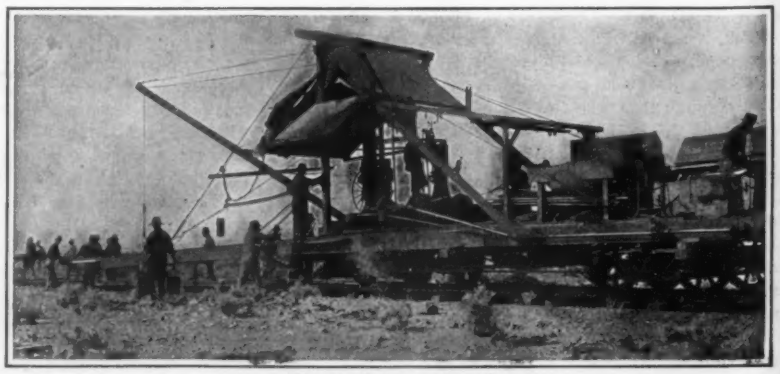
To plot the route the chief surveyor set out ahead of the main party. He ran the line by the aid of a compass, and checked his work by means of stellar observations. The last camel in his train was required to haul a heavy bullock-chain, the free extremity of which was knotted, and as this dragged over the ground it left a trail which could be picked up and followed easily by the main party following in the rear. The latter measured the distance and took levels at frequent points, and these were constantly checked. This survey party moved forward at a rate of five miles a day, covering the Western Australian section of 455 miles in 89 days.

The engineers working westward through South Australia experienced greater difficulty in completing their part of the undertaking; for on their section, extending to over 645 miles, the scarcity of water was felt acutely. They were caught by an exceedingly hot summer, and the engineer-in-chief records how it was impossible to use ink, as it immediately dried on the pen, and the lead dropped out of the shriveled pencils. Even the camels suffered terribly from the heat, and at midday the parched and blistered men had to take shelter from the fierce rays of the sun by burying themselves deep down in the sand. As a consequence, they were greatly delayed, and their average movement daily was but three miles. Eventually, however, they gained the interstate boundary, picking up the last stake in the route left by the party which had advanced eastwards from Kalgoorlie. This survey work occupied two years, and cost $100,000. Now came the question of the gage, and the matter was only settled after a warm discussion in the Commonwealth Parliament. There is no single country where one finds so many different gages as in Australia, varying from the narrow 3 ft. 6 in. gage up to 5 ft. 3 in. Every State has a different gage, a striking reminder of the foolish policy adopted by jealous States in the old days in order to close their boundaries to the traffic of their neighbors.

The Australians are the first to admit that these various gages constitute the principal weaknesses in their railroad systems, and they are gradually being converted to the recognized standard gage of 4 ft. 8½ in. The "desert" link, as this line from Kalgoorlie to Port Augusta is termed, is of that gage. On the transcontinental line, by which it is now possible to travel by rail from Perth in Western Australia to Brisbane in Queensland, no fewer than five different gages occur.

Preparations were now begun for the laying of the steel rails simultaneously from each end across the desert. There are no mountains or hills along the route, and very little elevation even. The only vegetation that exists in that untrodden and thirsty area is the everlasting bluebush and saltbush, which somehow cling to life even in Australia's most dreary and desolate regions. Leaving Port Augusta, the route lies for 425 miles through sandstone country. Then it enters what is called the Nullarbor Plain, a vast empty limestone plateau. Across this plain the railroad now runs in one straight line for

The chief engineer's private car



The track-layer at work

330 miles—quite the longest run of dead straight track in the world.

Over this whole region there was not a single water-hole, let alone a stream, and it was evident to the engineers that the question of water supply would be a tricky problem. Fresh water would be needed not only for the men during construction, but for the running of the railroad after it was built. After an exhaustive study of the conditions it was decided to take water from the big Mount Charlotte Tank at Kalgoorlie, and convey it along the line in pipes for delivery to locomotives from water-tanks situated about fifty miles apart, for a distance of 400 or 500 miles. The remaining part of the route runs through sandhill country, and at intervals there are natural rock-catchments. Here water was to be collected and stored in reservoirs and used as required. Although the country is desert, there is a small rainfall, varying from two to five inches a year, and if this could be caught and conserved it would suffice for the engines.

The headquarters-on-wheels for the construction work

The end of steel at both Port Augusta and Kalgoorlie became busy centers for activity as railroad material and stores were collected ready for the march forward into the desert. Hundreds of camels were requisitioned for transport work, as well as scores of mules and motor-cars. The camel proved the ideal beast for working in the desert, and it carried the engineers from point to point, and also drew the heavy wagons. The motor-car, too, proved very serviceable over the flat country where the sand was not too soft.

The engineer and his staff resided in camp-trains, which moved forward as the rails were laid. They were specially designed for use in the desert, and consisted of as many as seven to ten coaches, with a double roofing to keep out the intense heat, while all the windows and openings were protected against flies and insects by mosquito-proof netting. One coach was reserved as an office for the head engineer, next to which came the stores car, followed by a hospital car fitted with beds and every convenience for attending sick and injured men; the remaining cars served as living and sleeping cars for the staff. There were two of these towns on wheels, one operating from Port Augusta, and the other from Kalgoorlie.

The men attached to the running staff were accommodated in small and light wooden huts. Those used for sleeping quarters were protected from the fierce rays of the sun by an extra roof, carried down over the hut for a considerable distance. In the desert the heat was terrific and exceedingly trying, the thermometer frequently registering 130 degrees in the shade. At midday it was often impossible to work, everything, including the sleepers and rails, getting quite hot to the touch. The huts and all the dwellings were so constructed that they could be transported bodily by rail from place to place. Thus the camps were continually being moved as the rail-head advanced. They seldom remained in one spot for a greater period than three weeks.

As the country through which the railroad was being built was for the most part flat, very little grading was necessary. On no part of this 1,000-mile desert line does the track cross a river or climb a noticeable hill. Accordingly there was scant occasion for the services of the common laborer. It was simply a case of making an even bed on which the sleepers were quickly laid, and then came the placing of the steel rails across them by a tracklayer, and spiking and bolting them in position. The track moved forward at the rate of a mile a day. Water for the camp was brought up daily by camels, but it was necessary to make provision for supplying the locomotives when the railroad should be running. The party working eastward from Kalgoorlie laid special pipes from the reservoir there. At every 50 miles or so tanks were built into which the water could be pumped and stored until wanted.

Then one day the good people of Perth were somewhat surprised to hear that the engineer had telegraphed for a complete artesian boring plant to be sent out. The old miners and those who knew the land smiled at the very idea of water being found in that withered-looking country that lies behind the great Australian Bight. However, the machinery was despatched, and shortly

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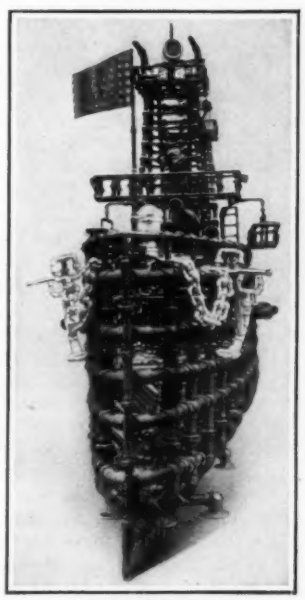
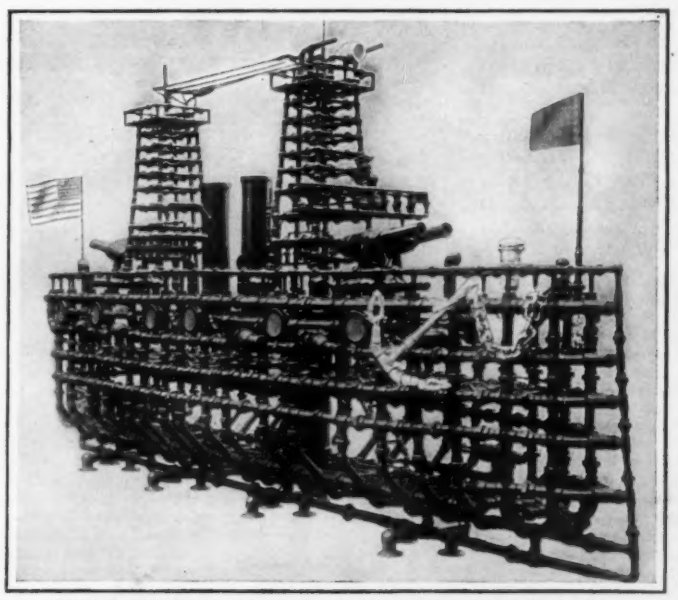


Bow view of the all-pipe dreadnought



Model of the battleship "New York" constructed entirely of pipe fittings

A Battleship of Pipe Fittings

IN these days of feverish shipbuilding all kinds of marine architecture are coming to the front. We read about wooden ships, concrete ships, steel ships, standardized ships, corrugated ships and so on. But there is a certain amount of freshness in the latest addition to our present collection, namely, a model of the super-dreadnought "New York," built entirely of pipe fittings and valves and plumber's specialties.

This novel battleship was designed and constructed in a Bridgeport plant devoted to the manufacture of pipe fittings. In completed form it was transported from Bridgeport to New York city on a large motor truck.

The overall dimensions of the model are: Length, 186 inches; beam, 34 inches; molded depth, 42 inches; total height from keel to top mast, 102 inches. Its weight is 3,308 pounds. In all, 6,669 separate pieces entered into the construction of the battleship. It is surprisingly complete, considering the nature of the material employed. A small electric motor gives action to the propeller. The ship is electrically wired throughout, the wires running in conduits. The mere pressing of a button brings the ship into action: the propeller rotates, the commander salutes, lights flash, guns roar, the wireless crackles, and the searchlight casts a piercing look about. The entire action is automatic and may be repeated indefinitely or until the pressing of another button stops it. A row of colored electric lights run from bow to stern over the mast tops, and when in action the model makes an attractive exhibition.

French Cameras Which Snap the Enemy's Works Against His Will

FROM time to time there have appeared short descriptions and illustrations of various types of cameras employed by aerial photographers. In the accompanying illustration the series is carried on by presenting several types of camera employed by the French air service.

The longest camera shown in the illustration is humorously referred to as the "vest pocket" camera by certain members of the French air service. It is over five feet long and built of light sheet aluminum. Like the majority of cameras employed in aerial reconnaissance, it is provided with a focal-plane shutter and makes use of plates. This particular camera is not of the magazine design; that is to say, each plate must be inserted by hand, exposed, and replaced by another as in the ordinary plate camera. Because of its bulkiness it goes without saying that the "vest pocket" camera is employed in special reconnaissance airplanes in which a well or hole is provided in the bottom of the nacelle or cockpit, through which the lens may be pointed.

Two other cameras shown are considerably smaller, although apparently constructed along the same general lines. However, because of their smaller size they can be pointed over the side of the airplane body and therefore lend themselves to more ready manipulation. The remaining camera, only part of which shows in the photograph, appears to be some form of a magazine camera for making continuous photographic records.

Some of the cameras employed by the French airmen operating over the Aisne sector

Mass of Material to Construct an Airplane

THERE is a surprising amount of material of various kinds necessary to build a single airplane of the more simple kind. Materials involving metals of various kinds include the following:

Nails	4,326
Screws	3,377
Steel Stampings	921
Forgings	798
Turnbuckles	276
Wire	3,262 feet
Aluminum	65 pounds

The various kinds of wooden material mount up as follows:

Spruce	244 feet
Pine	58 feet
Ash	31 feet
Hickory	1½ feet

Other material necessary for the finished plane is as follows:

Veneer	57 square feet
Varnish	11 gallons
Dope	59 gallons
Rubber	34 feet
Linen	201 square yds.

This mass of material is exclusive of everything necessary for the engine alone. This data is obtained from the Signal Corps Aviation Section.

World Markets for American Manufactures

Conducted by WILLIAM W. SNIFFIN

A department devoted to the extension of American trade in foreign lands

Government Control of Foreign Trade

ONE of the most important, if not the most important of the war measures adopted by the United States Government was the recent proclamations of the President restricting import, as well as export trade. All articles of foreign trade now require licenses. This does not mean, however, that trade will necessarily be curtailed; within certain limitations, it will be only controlled. The purpose of the restriction is two-fold—to prevent all trading with the enemy and to release vessels from trade in non-essentials and make them available for the transportation of troops and supplies.

The War Council which was recently held at Versailles, France, considered the balance to be maintained between the shipment of troops and their supplies on the one hand, and the transportation of goods needed by the allied armies and the European civilian populations on the other. Reports to the United States Government indicate that the policy will be to employ as much tonnage in the movement of American forces and the materials for their use as can be spared from its previous routes without endangering the Allies' food supplies. The Allies are drawing less and less on America for munitions, as every month they are increasing the volume of their own manufacture. This automatically releases tonnage for the movement of foodstuffs and for use by the American forces in France. It is estimated that at least a million tons of shipping will be released in this way.

Two proclamations were issued by the President—one for controlling exports and the other for controlling imports. Their texts are identical both in the list of commodities involved and the countries with which the commerce is being conducted. All trading in the following articles of commerce is subjected to the restriction of these orders:

> All kinds of arms, guns, ammunition and explosives, machines for their manufacture or repair, component parts thereof, materials or ingredients used in their manufacture and all articles necessary or convenient for their use; all contrivances for or means of transportation on land or in the water or air, machines used in their manufacture or repair, component parts thereof, materials or ingredients used in their manufacture, and all instruments, articles and animals necessary or convenient for their use; all means of communication, tools, implements, instruments, equipment, maps, pictures, papers and other articles, machines and documents necessary or convenient for carrying on hostile operations; all kinds of fuel, food, foodstuffs, feed, forage and clothing, and all articles and materials used in their manufacture; all chemicals, drugs, dyestuffs and tanning materials; cotton, wool, silk, flax, hemp, jute, sisal and other fabrics and manufactures thereof; all earths, clay, glass, sand, stone, and their products; animals of every kind, their products and derivatives; hides, skins and manufactures thereof; all non-edible animal and vegetable products; all machinery, tools, dies, plates, and apparatus, and materials necessary or convenient for their manufacture; medical, surgical, laboratory and sanitary supplies and equipment; all metals, minerals, mineral oils, ores and all derivatives and manufactures thereof; paper pulp, books, and all printed matter, and materials necessary and convenient for their manufacture; rubber, gums, resins, tars, and waxes, their products, derivatives and substitutes, and all articles containing them; wood and wood manufactures; coffee, cocoa, tea, and spices; wines, spirits, mineral waters, and beverages; and all other articles of any kind whatsoever.

The countries specified are:

> Abyssinia, Afghanistan, Albania, Argentina, Austria-Hungary, Belgium, her colonies, possessions and protectorates; Bolivia, Brazil, Bulgaria, China, Chile, Colombia, Costa Rica, Cuba, Denmark, her colonies, possessions and protectorates; Dominican Republic, Ecuador, Egypt, France, her colonies, possessions and protectorates; Germany, her colonies, possessions and protectorates; Great Britain, her colonies, possessions and protectorates; Greece, Guatemala, Haiti, Honduras, Italy, her colonies, possessions and protectorates; Japan, Liechtenstein, Liberia, Luxembourg, Mexico, Monaco, Montenegro, Morocco, Nepal, The Netherlands, her colonies, possessions and protectorates; Nicaragua, Norway, Oman, Panama, Paraguay, Persia, Portugal, her colonies, possessions and protectorates; Rumania, Russia, Salvador, San Marino, Serbia, Siam, Spain, her colonies, possessions and protectorates; Sweden, Switzerland, Turkey, Uruguay, or Venezuela.

The proclamations became effective on February 16th, 1918. The War Trade Board, which is vested with the authority to carry out the provisions of these orders, made a statement on February 15th, to the following effect:

> The military situation and the tonnage situation have made increasingly apparent the necessity of instituting a complete and thoroughgoing control of all our exports and imports. The transportation of our armies to France and the maintenance of a continued flow of the supplies and munitions needed to maintain them in fighting trim require the use of every ton of shipping which can possibly be devoted to these purposes.
>
> This demand must be met, and if it becomes necessary to curtail our exports or imports, these are measures which are forced upon us by the critical tonnage situation and the necessity of availing ourselves of every possible means of maintaining our armies in France.
>
> The limitation of exports is necessary also to conserve the products of this country for the use of our own people and the peoples of the nations associated with us in the war; we must dispose of this surplus in such a way as to aid, as far as possible, those countries to the south which have always depended upon us; we must also dispose of our surplus in such a way that Germany and her allies will derive no benefit therefrom; and we must secure for ourselves in return shipping and supplies urgently needed.
>
> The promulgation of these two proclamations does not mean an embargo on exports or a prohibition of imports, but places in the hands of the President the power to regulate, which he will exercise through the War Trade Board and the Treasury Department. This power will be exercised with the single purpose of winning the war, and every effort will be made to avoid unnecessary interference with our foreign trade and to impose upon our exporters and importers no restrictions except those involved in the accomplishment of definite and necessary objects.
>
> As heretofore, licenses for the export or import of coin, bullion, currency, evidences of debt or of ownership of property, and transfers of credit, will be issued by the Treasury Department; licenses for all other exports and imports, including merchandise, bunkers, ships' supplies, etc., will be issued by the War Trade Board.

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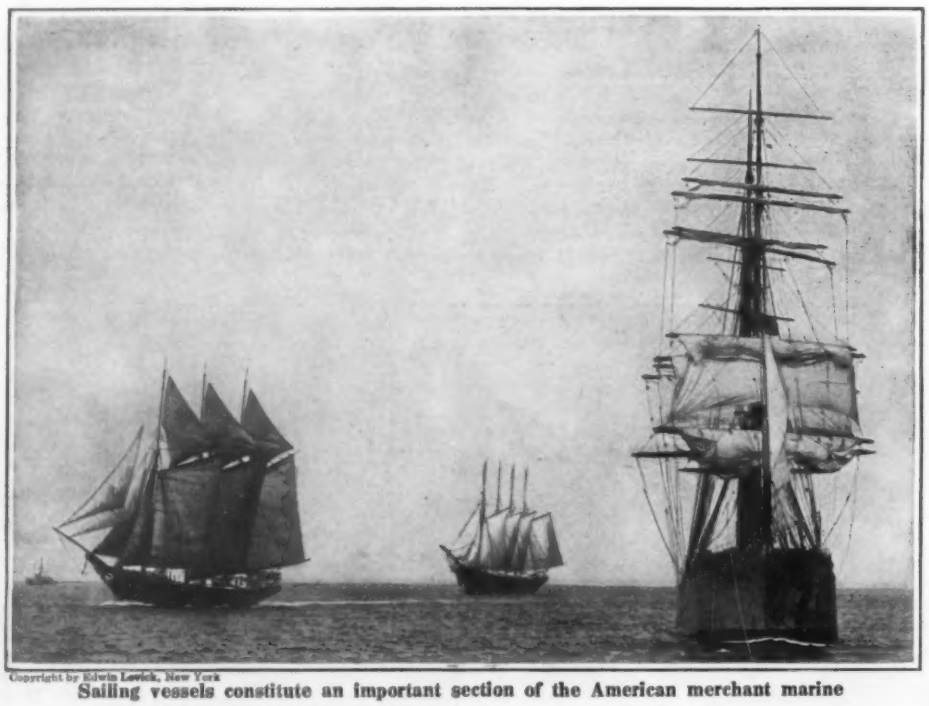
An old-timer still in active service. This vessel was constructed in 1853



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Sailing vessels constitute an important section of the American merchant marine

As a matter of fact, exporters, importers and shipping men do not, as a rule, seem to be apprehensive at this rigid system of licenses for the entire external trade of the country. The overseas trade has been through many vicissitudes in the last three yars and traders are thoroughly accustomed to anything that may happen. Besides they are fully determined not to stand in the way of anything that the Government considers necessary to help the war along. Several New York shippers are said to have declared that they do not expect to see the new licensing system followed by any immediate or drastic reduction in business, for the reason that such reductions have already automatically followed other developments, such as the ban on coffee futures, the restrictions already imposed on tonnage, etc.

Growth of American Shipbuilding

DURING 1916 the total number of American-owned merchant vessels of five tons net register or more—including those operating in inland, coastwise and foreign trade—was 37,984, with a gross tonnage of 12,500,000, according to a report recently issued by the U. S. Bureau of the Census. This report shows that the number of vessels increased only 1½ per cent in ten years, while the gross tonnage actually shows a decrease of five per cent for this period. The average tonnage per vessel for the entire United States decreased from 345 to 323 in the ten-year period. This decrease is accounted for by the marked falling off in the number and tonnage of sailing vessels and in the tonnage of unrigged vessels. The tonnage of all the vessels in the country is distributed as follows: Atlantic Coast and Gulf of Mexico, 6,509,000 tons; Mississippi River and the tributary rivers, 1,621,000 tons; Pacific Coast and Alaska, 1,186,000 tons; Great Lakes and St. Lawrence River, 2,738,000; and canals and other inland waters, 196,000 tons. In contrast to the general decrease in the total gross tonnage for the ten-year period the value of the vessels, the gross income from them, the amount of wages paid and the freight carried show marked increases, the first two almost doubling and the last increasing by nearly one-half. The actual value of the vessels is reported to be $960,000,000 and the gross income, $564,000,000.

Japan's Shipbuilding Industry

REPORTS have just been received in the United States giving actual figures for the shipbuilding activities in Japan during the first 11 months of 1917. The ships that were constructed with more than 1,000 tons numbered 64, the total tonnage amounting to a large sum. At the present time 105 merchantmen with an aggregate of 503,075 tons are being planned at the 14 principal shipbuilding yards of Japan. Under the Shipbuilding Encouragement Act of Japan, a bounty is granted by the Government to shipbuilding yards and by the terms of this Act the yards are required to notify the Government before work is begun on the construction of the vessels.

The Problem of the Unsinkable Ship

An Attempt to Render the Freightship "Lucia" Unsinkable by Means of Watertight Boxes

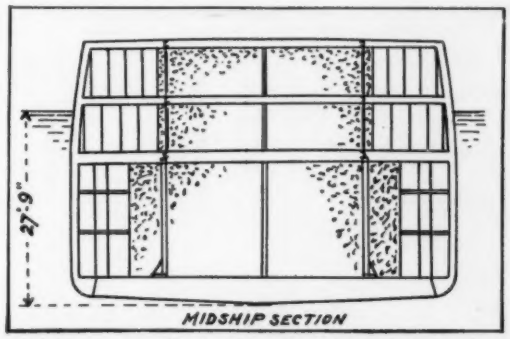
THE first officially recognized attempt to render a freightship so far unsinkable that she can take the blow of a torpedo without going to the bottom, is about to be put to a practical test by sending the "Lucia," formerly an Austrian vessel, through the submarine zone. Before very long, this ship will start for Europe with her sides, bulkheads, and the under sides of her decks padded with several thousand wooden water-tight boxes, upon whose buoyancy dependence will be placed for keeping her afloat, even if she should sustain injuries which would inevitably send her to the bottom under normal conditions.

The plans for rendering the "Lucia" unsinkable were worked out by Mr. William T. Donnelly, with the approval of the Naval Consulting Board; and judging from the announcement recently made in the daily press by Mr. Saunders, Chairman of the Board, great expectations are entertained as to the success of the venture.

It should be understood, of course, that this scheme of protection is to be regarded as emergency work done on ships already afloat—that is to say, it is not proposed to construct new ships along standard lines and then load them with wooden boxes in this fashion. In view of the great lack of tonnage and the urgency for getting our men and their supplies, to say nothing of food for the Allies, across to Europe, any plan which will conserve our shipping and cut down the loss without an undue expenditure of time and money, is entitled to a fair trial. Such, at least, we judge to be the attitude of the Naval Consulting Board in sanctioning this very ambitious experiment.

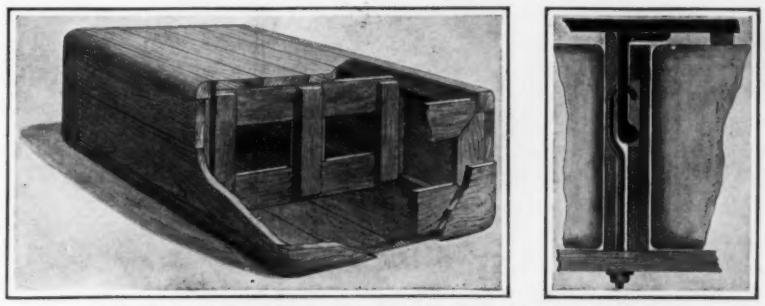
The "Lucia," which is 432 feet long by 49 feet broad and 38 feet deep, has a maximum deadload capacity of 10,000 tons on her maximum summer draft and of 9,400 tons at her maximum winter draft.

As will be seen from the accompanying line drawings, the ship has six watertight bulkheads, which divide her into five cargo holds, a boiler and engine room compartment, and a collision compartment at the bow. She has three decks, and the system of flotation boxes is applied throughout the full length of the cargo spaces on all three decks. The plans show the ship as arranged for carrying a cargo of coal. The shaded portions in the deck plans represent the extent to which the hull under these conditions, will be filled up with the flotation units. In her normal condition, the "Lucia" can carry 10,000 tons of coal but with the boxes installed she carries 8,300 tons. The total hold capacity of the ship is 508,000 cubic feet when she is provided with a sufficient number of flotation units to protect her against sinking. Of this 152,000 cubic feet will be taken up by the flotation units, and the balance of 356,000 cubic feet at 43 cubic feet per ton will be occupied by the load of 8,300 tons of coal.

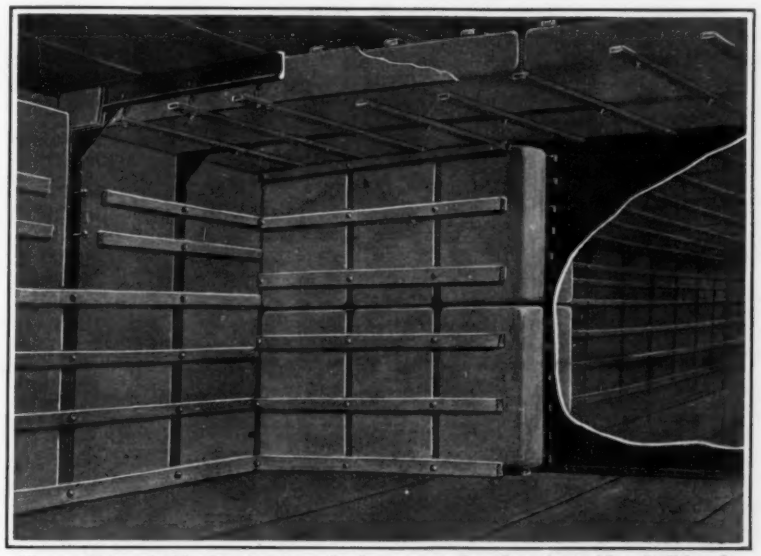


Midship section showing the "Lucia's" flotation units arranged for a cargo of coal

The flotation units are made in three sizes—the smallest is 12 inches deep by 25 inches wide and 3 feet, 1¾ inches long; the next is 18 inches deep by 27 inches wide and 5 feet, 9 inches long; the third, and largest, is 30 inches deep by 30 inches wide by 6 feet, 2 inches long. All the boxes are made of ⅛-inch North Carolina pine, and the details of construction are shown clearly in the accompanying sectional perspective view. Two interior transverse bulkheads are provided in each box, and all boxes are covered with galvanized metal to render them watertight. The various units are constructed to withstand pressures corresponding to 10, 20 and 30 feet of water, according to their location in the ship. The method of stowing the boxes is shown in a perspective view of one of the decks. It will be noticed that they are stowed in between the frames of the hull and between the deck beams on the under side of the decks. The boxes are held in their respective positions by means of battens and threaded bolts, the latter being hooked into the frames and deck beams, and the whole system being brought up snugly into position by means of washers and nuts on the outside of the battens.



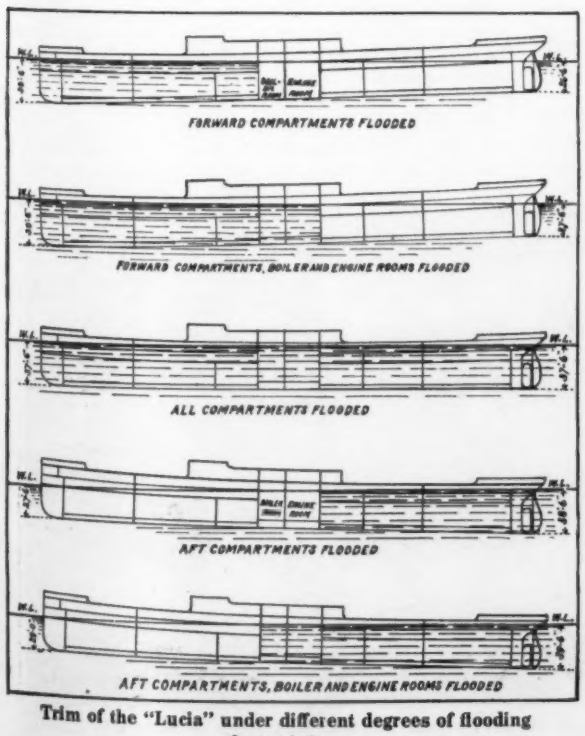
Details of a box and its method of attachment to ship's frames



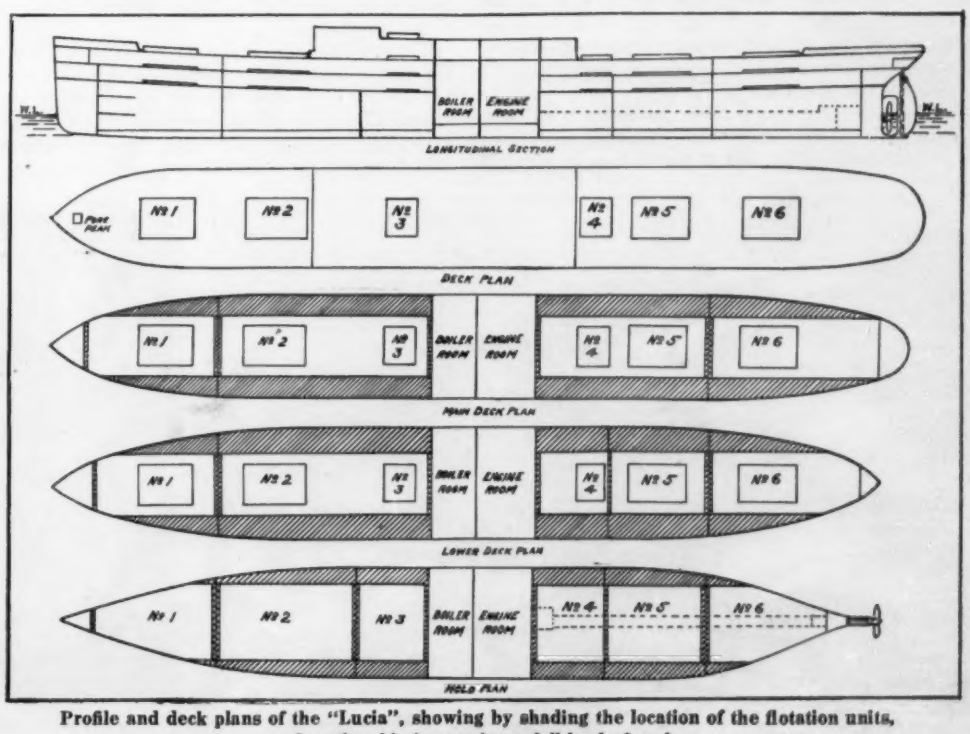
View within a hold, showing how the boxes are placed against sides, bulkheads and the under sides of decks

To render a ship unsinkable, three separate conditions are to be considered. First, when she is unloaded; second, when she is loaded with a mixed cargo, and third when she is loaded with a dense, heavy cargo, such as a cargo of coal. For the first condition, reserve buoyancy sufficient to make the ship unsinkable when she is unloaded, is attained by fitting a single layer of flotation units between the frames and deck beams and against the watertight transverse bulkheads. Cargo reserve buoyancy is determined by the nature of the cargo itself and the cubical area occupied. For instance, in the case of a 5,000-ton ship, 56 cubic feet is allowed per ton, making a total for that ship of about 280,000 cubic feet. The reserve buoyancy units necessary to float the ship when it is unloaded equals about ten per cent of this tonnage, or 500 tons, leaving a net tonnage of 4,500 tons or 252,000 cubic feet. A coal cargo requires 43 cubic feet of space per ton, which on the net tonnage of 4,500 tons amounts to 193,500 cubic feet. This is deducted from the total net cubic feet and leaves reserve space of 58,500 cubic feet for reserve buoyancy units to float the dead-weight cargo. It is claimed by the sponsor for this system that the loss of cargo space in a ship that is self-salvaging is more than offset by the salvaging of the cargo and of the ship itself.

Should this method of protection prove to be successful, it will provide a powerful incentive for the construction in all ships of permanent self-salvaging qualities—something which is sadly lacking in the average merchantship construction of the present day.



Trim of the "Lucia" under different degrees of flooding due to injury



Profile and deck plans of the "Lucia", showing by shading the location of the flotation units, when the ship is carrying a full load of coal

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts

Conserving the Life-Boat

THE launching of life-boats has always presented a serious problem. There are too many instances of life-boats being dashed to pieces against the side of the sinking vessel to elaborate on this particular danger, but suffice it to say here that of all the difficulties encountered, perhaps this one is the gravest and by no means the least common.

No one should be better informed in this respect than the president of a navigation company. So it is quite fitting that Mr. J. L. Hyland, president of a steamship line and a resident of Winnipeg, Canada, should have invented a safety device for use in launching life-boats. Mr. Hyland's device, it will be noted in the accompanying illustration, consists merely of a cradle-like arrangement of steel rods and rollers attached to the bottom and side of a life-boat. As the small craft is lowered, the cradle keeps it clear of the ship's side and prevents it from being broken or upset on the rails, guards or uprights. It is said of this device that it assures absolute stability with the vessel at any angle and under any weather conditions. Obviously, when the life-boat reaches the water the cradle can be released by an arrangement of chains and connecting rods.

During a recent demonstration certain U. S. Government officials were present. To all appearances the device serves its purpose well.

This life-boat can be safely launched because of the cradle arrangement

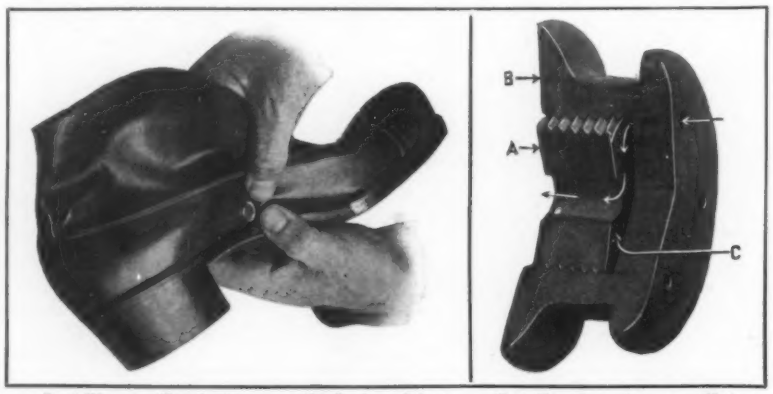
Fresh Air for the Shod Foot

LACK of air in the modern shoe is held by doctors to be the root of all foot evils. Sore feet, cold feet, perspiring feet, burning feet, tired feet, and every other variety of troublesome feet can generally be remedied by fresh air. But how is one to ventilate a pair of leather shoes?

E. J. Devlin of Newark, N. J., has been working on the problem of shoe ventilation for several years. As a result he has evolved an ingenious shoe ventilator which is inexpensive, practical, waterproof and inconspicuous. Above all, the device can be applied to any shoe by any one through the use of a punch selling for a few cents.

The foot ventilator, it will be noted in the accompanying illustration of the device in magnified form, consists of only two parts, a hub having two flanges and a screw. When the end of the screw *A* is even with the surface *B*, there is an air chamber or open space at *C* with access to the open air through four small orifices in the hub face. The screw has a central passage as indicated. Now when the foot is raised in walking, air is sucked through the small vent holes into the air chamber *C* and then through the central passage to the interior of the shoe. Dust or moisture from splash being heavier than air will not follow the tortuous course indicated by the arrows, hence falls to the bottom of the air chamber and generally passes out through the bottom orifice. The amount of air entering into the shoe may be regulated to a nicety by turning the screw in either direction; and if the flow of air is to be shut off entirely, the screw can be turned all the way so as to eliminate the air chamber and block the vents.

It is but the work of a few minutes to equip any pair of shoes with the new ventilators. Each shoe is placed on the edge of a thick board and a hole is punched through the hollow part of the arch. The ventilators, being of the proper size to fit the hole made by the punch, are merely pushed in place and hold fast after the manner of a collar button.



Just like a collar-button: method of applying a shoe ventilator

Details of a shoe ventilator, arrows indicating air path

Sleighing with a Motor

NOT long ago we illustrated a motor sleigh owned by the former Czar of Russia. Now we present an equally ingenious outfit shown to us by Guy Anderson, of Haynesville, Me., who developed it and has been using it this winter on the snow covered roads of Aroostook County.

The inventor gives us a good deal of information about the details of his sleigh. Perhaps of greatest interest are the flexible strip steel runners by means of which he steers. These are formed of steel straps arranged on each side of the supporting runner, which is equipped also with a central projecting fin to minimize skidding. The driving wheels may be raised or lowered in connection with the runners, to meet different conditions of the roads, by means of a hand lever located at the left of the driver.

Mr. Anderson's sleigh has seen hard usage during the winter, and has made good unreservedly. Equipped with a snow plow, it has plowed a road through a field lying under a blanket of two feet of snow. It backs and turns around satisfactorily, and turns out of the road to pass another vehicle without any indication of skidding. Nor does a patch of bare ground stop it; it takes such an obstruction on low gear without difficulty.

Claims in Patents

THE practice in the United States with reference to drawing patent claims has been criticized from time to time because of the difficulty in determining what is the new feature in a combination where the old as well as the new elements are positively included. While such a claim may define the combination as a whole, it does not distinguish the new from the old, and it is, therefore, necessary for an attorney in construing a patent to make a study of the prior art to ascertain in what the improvement consists.

In some countries an entirely different practice has been followed in drawing claims, the inventors' attorney being obliged to draw the claims in such a manner that when the claims are read, there may be no confusion of the improvement with the elements old in the art. When this is done, any attorney may at once see in what the invention consists. In the countries where this practice is followed, the Patent Offices hold that unless the improvement is distinguished from the old elements in the claim, the invention is not defined as is required by the law. In other countries it is necessary that a carefully prepared statement of the prior art be included in the specification which makes it possible from an examination of the Letters Patent to determine the extent of the invention and the scope of the claims in the Letters Patent.

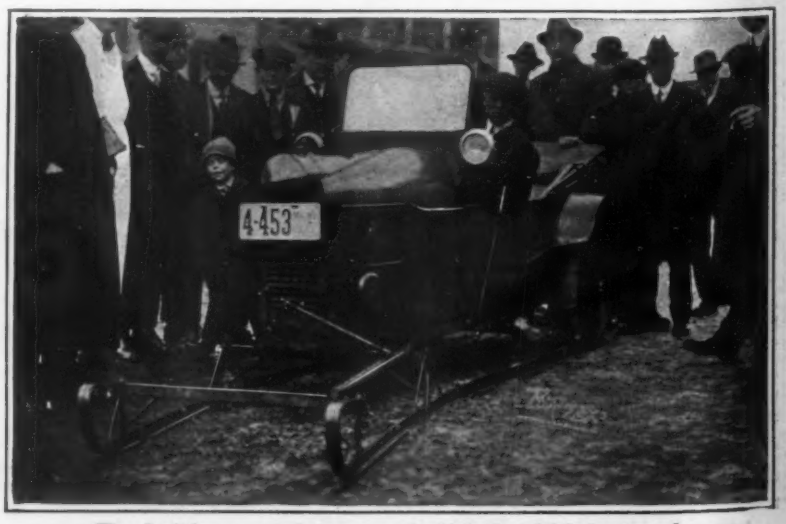
Until recently the United States Patent Office has not looked favorably on claims in which the improvement in the combination is distinguished from the old elements, but the advantages which would arise from the use of this form of claim have been apparent, and after much discussion the practice has been approved in Ex Parte Jepson.

While it may still be advisable in certain cases to draw patent claims in accordance with the old practice, there are many cases in which attorneys should take advantage of the recent ruling.

Bacteria in Bottled Water

THE U. S. Bureau of Chemistry has carried out an investigation to determine whether or not an injustice might be done to a bottler of drinking water through a bacteriological examination of his product a long time after bottling, owing to changes in the flora occurring during storage. The conclusion was reached that no such injustice could be done, as most organisms, including *B. coli*, fall off in number during storage. A few species which tend to multiply, are not associated with pollution. The presence of a considerable number of molds in bottled waters is clearly indicative of storage.

A 700-pound motor sleigh that makes over 30 miles per hour



The flexible runners by means of which the sleigh is steered

RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Pertaining to Apparel

GARTER.—J. C. ROGERS, care of Ducks Lumber and Coal Company, Gates Building, Kansas City, Mo. The object of this invention is to provide a garter which is simple and durable in construction, arranged to permit the user to conveniently place the garter in position on the leg and attach it to the hose or stocking, and to draw the leg band taut around the calf of the wearer's leg by the downward pull exerted by the hose or stocking.

Electrical Devices

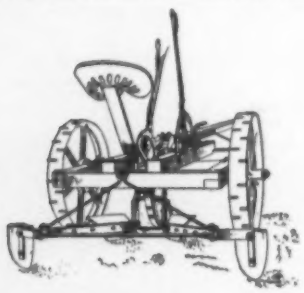
ATTACHMENT FOR TELEPHONE.—V. T. MILLER, 1900 N. Main St., Hutchinson, Kans. The invention has for its object the provision of an attachment for locking the mouthpiece to the transmitter. The device comprises a plate of thin sheet metal, shaped to fit over the transmitter at the mouthpiece and having a central opening for receiving the extension. At this central opening the plate has struck up lugs which are adapted to engage notches in the mouthpiece and to lock it against turning.

TAPE TRANSMITTING APPARATUS FOR TRANSMITTING ELECTRICAL IMPULSES.—H. K. HARRIS, 96 Victoria St., Westminster, London, England. This invention relates to tape transmitting apparatus by means of which electrical impulses can be transmitted in any desired sequence over one or more lines. The device while being applicable for transmitting electrical impulses generally is especially suitable for transmitting such impulses for the purpose of operating electrical devices for making public announcements, exhibiting advertisements and other analogous purposes.

Of Interest to Farmers

CORN HUSKER.—G. L. MILLER, Geneseo, Ill. The invention relates to corn huskers, its object is to provide a device forming an instrument by which the husks are stripped from the ear, and by means of which the corn may be broken or snapped from the stalk, without undue strain on any part of the hand.

IRRIGATION PLAN.—J. B. CRANE, Ellensburg, Wash. The object of this invention is to provide a plow especially adapted for forming irrigation ditches, wherein the plow is supported for adjustment vertically to provide for different depths of ditches, and wherein mechanism is provided for

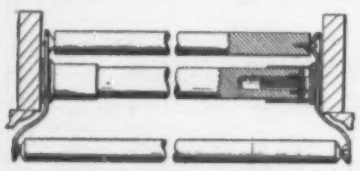


A PERSPECTIVE VIEW FROM THE REAR, AND A VIEW SHOWING THE HARROW CONSTRUCTION

smoothing the ground on each side of the ditch and preventing clods and the like from falling into the ditch; the plow is so arranged that one or three ditches may be simultaneously plowed, as may be desired.

Of General Interest

CURTAIN HANGER.—J. J. FUERTHMILLER, Elkton, S. D. The invention has for its general object to provide a device wherein blind and curtain supporting brackets are provided, together



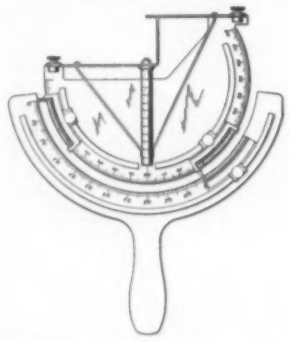
A TOP PLAN VIEW OF THE HANGER

with means for clamping the same by end pressure to the casing of the window without the necessity for nails, or screws, or of tools.

ZIGZAG-COURSE CONTROL.—E. E. HALL, New Eltham, London, England. This invention relates to course controls and particularly to a construction whereby the steersman may instantly shift the direction of travel of the ship without an audible order from the officer in charge, the device may be adjusted and the plan or course varied as often as necessary and yet maintain the ship near its true course.

REFLECTING CONDENSER FOR ENLARGING PHOTOGRAPHS.—R. D. GRAY, Ridgewood, N. J. This invention relates to apparatus for enlarging photographs with the aid of artificial light, its object is to provide a reflecting condenser for enlarging photographs with the aid of a single source of artificial light arranged to insure a uniform illumination of the image thrown on the sensitized medium held on the screen or dish. In order to accomplish the result the inventor makes use of a reflecting condenser having reflecting portions of varying intensity.

NAUTICAL INSTRUMENT.—G. KOFFSKEY, care of Dr. F. J. Hartley, 730 Clovet St., New Orleans, La. This invention relates to an instrument for solving mechanically the astronomical triangle, it is particularly adaptable for navigation purposes. Another object is to provide an instru-



A TOP VIEW OF THE INSTRUMENT

ment by which the sun gives the position of the instrument at any hour of the day, consequently the position of a vessel at sea may be determined, the determination of the exact location depending on the accuracy of the elements constituting the device.

SUNKEN-SHIPS-EMERGING APPARTUS.—S. P. PORTELLA, Sao Paulo, Brazil. The invention relates to ship raising devices. An object is to provide an inflatable member with casings formed with means for interlocking with parts of the sunken vessel so that when the casing has been placed in position the inflation of the inflatable members will cause an upward lifting action in proportion to the amount of water displaced.

PENCIL.—D. F. OLIVER, 2610 E. 14th St., East Oakland, Cal. The invention relates to pencils having movable leads, its object is to provide a pencil arranged to securely hold the the movable lead in projected position for writing or drawing purposes, and to allow convenient feeding of the lead outwardly to project the lead terminal a desired distance beyond the point of the stock or barrel of the pencil.

PENMANSHIP GUIDE CHART.—H. D. WILKES, 3675 Broadway, New York, N. Y. Among the principal objects which this invention has in view are, to control the movements of a writing instrument for governing the height of the letters in written composition, to form a guide governing the line spacing of the written composition, and to provide a simple and inexpensive device for accomplishing the above object.

DUST SEPARATOR.—J. L. ALDEN, Trench Warfare Section, Gun Division Ordnance Dept., Washington, D. C. This invention relates to separators of that type in which air, gas or other elastic fluid is separated from solid particles by the combined action of centrifugal force and water sprays. The invention has for its object the construction of a device so designed that it has a maximum separating capacity for a minimum amount of space and power consumption.

MIXER.—R. CHAPARRO, R. Valparaiso, Chile.—The invention comprises a cup having a rigid side handle provided with a vertical rigid extension, a bar hinged vertically to the other side of the cup, and a presser hinged to the side extension and adapted to interlock with the opposite hinged bar for clamping the cover upon the cup substantially.

FRAME.—J. LYNCH, address J. B. COYLE, 27 Cedar St., New York, N. Y. The object of the invention is to provide a metallic frame in which there is a driving fit between the channeled members and the corners of the frame. By keeping in stock various lengths of channeled members, any size of frame can be quickly built up. Furthermore frames already in stock can be easily taken apart and remodeled at comparatively little expense and labor.

HANGER.—V. H. MANKEY, 1110 S. Kline St., Aberdeen, S. D. The invention relates to means for suspending harness, collars, automobile tires, or other articles, either for storage or display whereby ready access may be had to each article without the necessity for disturbing any other article. The hanger is composed of few parts, not likely to get out of order, and is automatic in operation.

PAVEMENT.—W. JOHNSON, 819 Hibernia Bldg., New Orleans, La. The object of this invention is to provide a pavement composed of slabs of cement or concrete having interlocking tongues and grooves, and having openings through which grouting may be poured after the slabs are laid to provide points of support for the slabs.

CUSHION COVER FOR FRUIT CRATES.—I. W. PECK, 683 College St., Macon, Ga. The object of the invention is to provide a cushion for preventing injury to fruit during transportation, as for instance peaches and the like, this particular type of cushion is connected to the under face of the cover in such manner that the fruit is held tightly in the receptacle, yet yieldingly to prevent injury to the same from movement in the crate.

COMPOSITION FOR HARDENING STEEL AND SIMILAR METALS.—Z. T. CLARK, 902 Pacific St., Portland, Ore. The invention relates to a composition in liquid form for tempering and toughening steel, iron and similar metals. The mixture utilized results from the intermixture of the following in substantially the following proportions: Linseed oil, 4.75 gallons; copper sulfate, 6 ounces; common salt, 5 pounds; unslaked lime, 2 pounds; zinc, 2 ounces; oxid of iron 4 ounces.

DISPENSING DEVICE.—S. A. DEANES, Box 165 West Point, Miss. The invention is in the nature of a bottle or similar holder for a drink it includes in connection with such bottle and its closure a drinking tube which is confined within the bottle and immersed or partly immersed in the liquid contained therein, a float encircles the

SIDE VIEW SHOWING DRINKING TUBE BUOYED UP

drinking tube near its lower end and is adapted when the tube is released from confinement by the closure of the bottle to buoy the tube up in the liquid so that the upper end will protrude beyond the mouth of the bottle, that it will not be necessary for the user to handle the drinking tube.

Hardware and Tools

DOOR HANGER.—N. MILLER, address, Valdemar, Lidell Pittock Block, Portland, Ore. One of the principal objects of the invention is to provide a door hanger of the lever type, by means of which the door is hung free of rollers, runners or other devices, in such a manner as to be capable of movement into opening and closing positions along a constant horizontal line and with a minimum amount of exertion, the device may be so adjusted that the door will return automatically to closed from open position.

LATHE CHUCK.—C. J. FISHER, 1815 16th St., Niagara Falls, N. Y. The invention has for its object to provide a lathe chuck having a jaw which may be readily removed for reversal or to permit the use of another chuck jaw. The devices comprises a jaw having a recess and a guideway leading thereto, an anchor block, means to advance the anchor block, an anchor jaw movable in the recess and adapted to lock against the anchor block and means disposed in the guideway in the jaw for operating the anchor jaw.

HINGE.—J. DUNNER, 547 Howard Ave., Brooklyn, N. Y. The object of the invention is to provide a construction whereby there is produced only two pieces which include the usual knuckles pintles and securing means. Another object is to provide a hinge formed from sheet metal in such a manner that part of one blank will be curled around part of another blank for producing the pivotal connection between the two leaves.

BURGLAR-PROOF SASH LOCK.—J. GIANNINOTO, care of Manhattan Briar Pipe Co., 425 Greenpoint Ave., Brooklyn, N. Y. The invention relates to a sash of the type in which coacting elements are arranged on the meeting rails of sliding sashes. Among the objects are to provide a burglar-proof locking means of simple construction that may be cheaply produced and readily secured, to provide for positioning the parts so as not to interfere with the relative movements of the sashes when it is not desired to lock them

Machines and Mechanical Devices

ATTACHMENT FOR PAPER FEEDING MACHINE.—A. P. GREENE, Watertown, N. Y. This invention relates to machines for automatically feeding a single sheet of paper, card, or the like to printing presses or bag machines, and more particularly it is intended for use in connection with a machine for feeding flattened bag tubes to bag machine.

ROCK PULVERIZER.—E. A. VELDE, 510 F. Ave., West Cedar Rapids, Iowa. The object of this invention is to provide a device wherein the pulverizing machine is in the form of hammers detachably connected with a rotor, and so shaped that every surface of the hammer may be used, and wherein detachable linings are provided for coöperating with the hammer.

GREASE CUP.—H. E. ARGO, 431 S. Dearborn St., Chicago. The invention relates to a device consisting of a bearing, the combination with the shaft and the oil cup, of an adjustable tube extending through the oil cup into contact with the shaft, the tube having its ends open and having radial openings within the cup, and a spring normally pressing the tube toward the shaft. The lubricant feeds through the top of the tube and through the radial openings to the shaft thus thoroughly lubricating the same.

Medical Devices

FORMALDEHYDE THERMOMETER HOLDER.—L. MARTOCCI-PISCULLI, 235 Second Ave., New York, N. Y. This invention relates to thermometer holders of the type in which the thermometer by being inserted in the holder is freed from germs, so that there will be no danger of contagion when the thermometer is used on one patient after another, provide that the thermometer is inserted in the holder after use on each patient.

DENTAL BLOWPIPE BURNER.—J. A. DE CARVALHO, JR., Rio de Janeiro, Brazil. The object of the invention is to provide an apparatus for the production in quantity and with sufficient pressure, of the gases from alcohol, and for utilizing the heat produced by their combustion. The principal characteristics of the apparatus are, that it is able to carry out the work generally done by the employment of carbonic gas, gasolene or kerosene, employing alcohol of 36 degrees.

Railways and Their Accessories

TRIP FOR RAILWAY SWITCHES.—P. EVANS and D. DUTT, 231 E. End, Alma, Mich. The invention relates to automatic railway switches adapted to be operated by a train trip, mounted on a locomotive, or in the case of street railways on a car. Among the objects are to provide a trip having a resiliently sustained contact member to engage the track devices, and to provide a resilient train trip of strong and simple construction that may be mounted on a locomotive or car.

Pertaining to Recreation

TOY.—P. J. BERTUCCI, Box 316 Cliffside, N. J. Among the principal objects of the invention are to afford amusement and exercise to a person using the toy, to afford means of ascertaining the status of a contest when playing a game using the toy, to increase the skill of a player, and to provide a flying device which when properly handled does not bound. The invention comprises a flat surfaced racket, a disk-like missile, means for controlling and guiding the fall of the missile through the air, and means for causing the missile to adhere to the racket when dropped upon it.

Pertaining to Vehicles

PNEUMATIC TIRE ARMOR.—S. G. SMITH, 400 W. 148th St., New York, N. Y. The invention relates to protecting devices for pneumatic tires, and has particular reference to armors designed to be easily applied to the tread portions of wheels for emergency purposes or to be worn permanently if so desired. The tread is substantially imperforate and on each side is provided a series of straps or tabs of a flexible nature extending toward the axis of the wheel, flexible stays being provided extending across the tread and along the tabs to which they are connected.

WIND-SHIELD CLEANER.—C. A. BRIDGWOOD, Westwood, N. J. The object of the invention is to provide a wind-shield cleaner, for automobiles, trolley cars, locomotives, and the like, so arranged as to enable the driver or operator to start the mechanism at any time, to clean both the inner and outer faces of the shield, of any accumulated moisture, sleet, snow, rain, or dust without stopping the vehicle or interfering with the proper running thereof. The device can be readily applied to power-driven vehicles as now generally constructed.

FRONT DRIVE FOR MOTOR-DRIVEN VEHICLES.—M. KIMBLE, Wayne, N. J. This invention relates to automobiles, autotrucks and similar motor-driven vehicles. In order to accomplish the desired result use is made of a yoke, links connecting the ends of the yoke with angular arms on the stub axles pivoted on the front axle, and a driving gear mounted partly on the angular arms and connected with the front wheels to drive the latter, and a motor-driven gear connected at the yoke with the driving gear.

AUTOMOBILE SEAT.—J. H. SCOTT, 789 E. Yamhill St., Portland, Or. The object of the invention is to provide mechanism for use in connection with automobiles, to permit the cushions of the seats to be converted into a mattress. The cushions are supported by sectional holding bars which are arranged longitudinally of the body, and which rest upon the rear seat, the front seat, and a tripod the weight of the bars and plates need not exceed 25 pounds and can be stored beneath the rear seat.

TRACTION SHOE.—M. D. BYRNE, JR., 1363 N. Main St., Waterbury, Conn. Among the principal objects which the invention has in view are, to avoid wear upon and cutting of automobile tires, to provide renewable wearing sections, to provide friction traction surfaces, and to reduce the cost of traction shoes. As the blocks forming

PERSPECTIVE VIEW OF A SHOE

the face of the shoes become worn they may be readily replaced by new ones. It is claimed that wheels equipped with shoes constructed according to the invention, are relieved from excessive wear incident to service of heavy trucking on frozen country roads.

WIND-SHIELD.—I. W. PECK, 683 College St. Macon, Ga. The object of this invention is to provide a wind-shield composed of a fixed portion connected with the vehicle, and a detachable portion carrying the glass and held within the fixed portion in such manner that the impact of a body of sufficient weight against the glass will displace the detachable frame and the glass, thus avoiding injury to the object striking the glass.

METER.—M. SMITHEY, Lawrenceville, Va. An object of the invention is to provide a simple form of meter, in which a speedometer is combined with a number of odometers, each odometer being adapted to register the mileage of a particular portion of the vehicle, such as a particular tire. A further object is to provide a device which has few parts, which is cheap to manufacture, and which will not easily get out of order

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

The Current Supplement

AN interesting paper in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT deals with *Economic Industrial Applications of Electricity*, as a potent means for conserving fuel and human energy. *Ancient Clock Jacks* describes a number of curious mechanical figures that were formerly to be found on English clock towers. Several of these are illustrated. *Effective Methods of Fly Control* reviews, and brings up to date, the various factors that underlie the problem. *Evolution of the Human Face* traces the chief stages of its development from the lowest forms of life to man, a valuable paper, illustrated by a large number of photographs and drawings. Another important paper is *Focusing X-Rays*, which discusses a problem of great importance to physical science. It is accompanied by a number of illustrations. With the fast growing use of aircraft the importance of a wider knowledge of meteorology is being recognized, and a report of great importance in this connection will be found in the paper on *Meteorology and Aeronautics*, which deals with physical properties and dynamics of the atmosphere. A number of shorter articles of general interest will also be found in this issue.

An Additional Lifting Force for Airplanes

(Concluded from page 211)

ported by the airplane itself but by the inertia of the moving particle of air. The velocity of the air and its density therefore are important factors in the sustaining strength of this beam.

In physics this phenomenon is a consequence from what is known as the Bernoulli theorem and it seems from this that this lifting force increases with the density of the material in the stream and with the square of the velocity. If this is correct this lifting force would increase rapidly with an increase of velocity of the air in the stream.

There is a very strong tendency of this force to produce oscillations in a flexible plane; it is this phenomenon which produces the flapping of the loose end of a flag in the wind. This tendency is so strong that a piece of apparatus carefully made of hinged links of sheet iron, was instantly torn to pieces under a stream from a compressed air chamber. Under the air stream of a propeller having only two blades the resulting pulsations in the air streams also gave rise to quite powerful tendencies to oscillate; so great were these oscillations that it was difficult to measure the average force.

The exact form of the curvature of a plane under an air stream to obtain the best results, seems to be of considerable importance, as slight changes of curvature seem to change the results very decidedly. A perfectly straight plane gives very poor results. The air stream expands and is no doubt also drawn downward by the vacuum caused by the presence of such a plane; the correct shape of the plane seems to follow this curvature approximately; the plane should be sufficiently far from the stream to produce a partial vacuum between them, but should not be too far off to have this vacuum too easily broken by inrushes of air from the sides.

By moving such a plane through a range of angles this force will be found at first to increase as it approaches parallelism to the stream, then attains a maximum, and then reverses when the stream impinges directly on to it. The best shape seems to approximate that of the large end of a trumpet cut in half, though a recent test showed that the air stream a short distance from the propeller at first contracts slightly, hence the first part of the plane nearest the propeller should rise slightly at first and then bend downward. If extended too far along the length of the stream that component of this force which is in the opposite direction to the forward motion of the airplane, may become too great.

Immediately below the propeller blades this suction force was found to increase very greatly, being of the order of magnitude of twelve to fifteen pounds per square foot; but there were no means of measuring how much of this, if any, reacted down-

wardly on the propeller shaft, hence how much was a net gain.

This same kind of force probably exists in modern airplanes over the rear parts of the wings. Such wings are now usually made thicker in the middle as shown in the cross section in Fig. 5. When such a wing or plane is forced forward, the curved top of the wedge-shaped edge produces a partial vacuum over the rear part *aa*, as shown; the forces here are technically called negative pressures, and they seem to be quite important relatively to the positive pressures from below up. But these negative pressures are produced by the forward motion of this wedge-shaped wing through the air, hence diminish with the speed and are therefore zero at the time of starting; they are therefore characteristically different from those produced under the stream of air from the propeller; moreover the driving of this wedge through the air must retard the forward motion somewhat, hence must require additional propeller power to overcome it, while the lifting forces produced under the air stream require no extra power; they are available forces now wasted.

In air ships of the Zeppelin kind this additional lifting force could be made available if desired by merely adding appropriate planes below the air streams of the propellers. It would be available also for submarines.

Some very crude tests recently made with such planes under the air stream from a two-bladed propeller driven by a stationary airplane motor, showed that the principle was correct and that there was quite an appreciable lifting force, well worth making use of; the conditions in this case were, however, not favorable to the utilization of this force and it is likely that it could be considerably increased if the conditions were made more favorable. If for instance the velocity of the air stream could be doubled, this force could be expected to be quadrupled; and as it is naturally strongest near to the propeller, a multiplicity of propellers would be more favorable; if practicable a propeller might be placed at each end of the shaft of the motor, the rear one increasing the speed of the air stream in which it is moving. Other modifications suggest themselves when more attention is given to the better utilization of this additional lifting force.

Can Coal Be Pumped?

(Concluded from page 211)

used or carefully constructed pipe lines, which would be safe against leakage, laid through the existing tunnels and centrifugal pumps employed which would pump the coarser grades of coal, even lump size if desired, thus making it much easier to free the coal from water in large settling basins.

Modern hydraulic dredging plants dig and pump solid rock, hardpan, gravel, sand and earth in surprisingly large quantities, through lines ranging from several thousand feet up to over a mile for lighter materials, and to a distance of several miles where booster pumps are introduced into the pipe line. This makes it perfectly safe to state as a fact, that the coal dumped from the cars on the Jersey shore into bunkers could be fed into basins in a steady flow, from which it could be pumped across the river in a 24-inch line to the amount of from 15,000 to 20,000 tons per day, or as fast as it could be hauled away, and at a cost, on a maximum delivery, of not to exceed 15 to 20 cents per ton. Several pipe lines could be installed for a cost of about $100,000 or from three to six lines depending upon the size of the line.

This latter plan applying to the pumping across the Hudson would be for emergency use, the contractor, who could readily be found, to supply the pumping plant; but as a permanent plan there is no apparent reason why pipe lines from the mines to New York should not eventually be installed in place of laying additional railway tracks or providing further new equipment. The coal could be delivered directly to the power plants in Jersey, Manhattan, Brooklyn or the Bronx at a cost of presumably one-tenth the present

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cost by rail, and a still further saving in delivery by lighters and by motor trucks.

The methods of piping fuel are not experimental, but have been worked out to the greatest degree of efficiency, and the great oil companies only use railway transportation for distribution of small quantities of fuel oil. The investigation of this scheme should be carried out by the existing Government railway organization, as to the coöperation of the mining and railway interests, who certainly would find enough to recommend the plan; and no fear need apparently be had that the railways would lack for tonnage as a consequence of its adoption.

The questions affecting the Port, and the power companies, should be investigated by the New York and New Jersey Commission, and by the respective Public Service Commissions. Unquestionably conditions brought about by the war, have made it plain that we need an entire readjustment of our transportation systems, and that a new method of transferring power or transporting coal may be a governing factor in the final determinations of many of our most serious problems.

Australia's First Transcontinental Railroad

(Continued from page 213)

afterward the whole of Australia was thrilled by a telegram that came over the wires, announcing that at a point 350 miles from Kalgoorlie, on the dreary Nullarbor Plain, water had been found.

"I baled out 70,000 gallons of water," said the engineer in his telegram, "from the bore sunk at the 127th meridian of longitude, and then took samples. The water is of good quality, no salt, a little hard; but I think the iron in it would account for that. It should be good water for boiler purposes." The bore was sunk to a depth of 1,300 feet before water was struck, when it welled up to within 400 feet of the top. At another point, 100 miles further on, brackish water, but usable for locomotives, was again struck at a depth of 900 feet.

This discovery of water not only relieved the engineers of considerable anxiety and greatly lessened their work, but bids fair to change the whole aspect of the country. There is more than sufficient water for the needs of the railroad, which means that it can be stored and used for irrigation and pastoral purposes. Experts of the Federal Government who have visited the region and made surveys of the conditions declare that there is no reason why a great portion of the Nullarbor Plain, hitherto regarded as valueless, should not become a great grazing country, carrying at least three million sheep. Thus the railroad which was to conquer space and bring the Western State into rapid and easy communication with her eastern neighbors has shown how at least a large portion of the desert can be reclaimed.

From these two bores water is now carried a considerable distance westward to Kalgoorlie and eastward toward Port Augusta. In the sandhill region which stretches from the 640 to the 740 mile post from Kalgoorlie, there exist natural rock-catchments. The average annual rainfall in this region is about five or six inches, but it is rapidly lost in the parched earth, and there is not a surface stream of any kind. Several of these depressions were cleared out, their bottoms covered with a lining of concrete, and all outlets closed by strong banks. This work was pushed forward in the height of the summer. Then came the rains, and to the delight of the engineers their reservoirs were soon filled to overflowing, the largest one with 7,000,000 gallons of pure water. On account of the heavy loss through evaporation the reservoirs are covered with a roof of corrugated iron.

The water problem being solved, construction work was pushed forward as rapidly as possible, and in due course railheads met, and the last link of the long chain was forged. For the first time through railroad connection from the east to west of the island continent was an accomplished fact. Today it is possible to

(Concluded on page 223)

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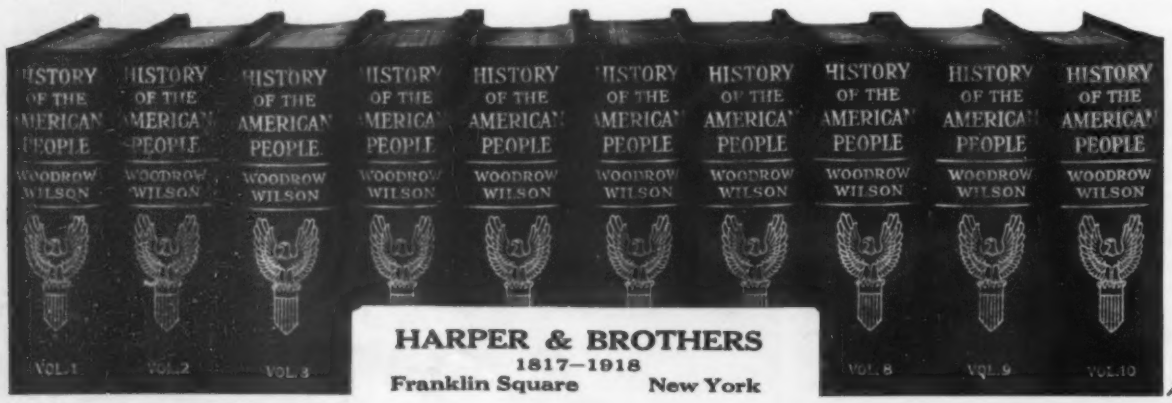

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Australia's First Transcontinental Railroad

(Concluded from page 221)

travel by rail from Perth, the capital of Western Australia, right away to Brisbane, Queensland's leading city, passing en route through Adelaide, Melbourne and Sydney, a route joining up the capitals of the five States of the Commonwealth, representing a total journey of 3,895 miles. As already stated, the work has occupied five years and demanded an expenditure of $35,000,000.

This interesting transcontinental line from east to west is to be followed by another from north to south. From Oodnadatta, the utmost limit of the Adelaide line, in South Australia, the track is to be continued northward through desert and only partially explored territory to Pine Creek, whence the rails run to Darwin, on the north coast. The whole of the route has now been surveyed, and after the war the laying of the steel ribbons will begin.

The transcontinental line just completed means much to Australia. It has already opened up one gold field and at least one copper field. The railroad will reduce the time of the journey from Perth to Melbourne from five to two days, and bring the eastern cities of the island continent much nearer the mother country, for it is proposed to convey the mails by the new route and not by boat as hitherto. Incidentally, too, it brings western Australia's capital nearer the United States.

Preliminary Facts Concerning the Browning Guns

(Concluded from page 205)

minutes 16 seconds without a malfunction, and with only three stoppages, these being due to defective cartridges.

The light weight but sturdy tripod of the Browning heavy gun permits the ready laying of the gun on its target. The cartridge belt is held in a wooden box fastening on the left side of the gun, as in the case of the Colt machine gun; this and the pistol grip of the new gun are reminders of the earlier gun of Mr. Browning's conception. This same gun, with certain modifications including the stripping of its water jacket, weighs but 22½ pounds and should prove satisfactory for aviation service.

It is still too early to pass judgment on the workability of the weapons under actual battle conditions. But as far as convincing tests are concerned, the guns have produced a most favorable impression. Furthermore, their design reflects the years of experience of the inventor in firearms of all kinds. As a quantity-production problem, moreover, both guns are ideal in every respect, permitting the maximum employment of automatic machinery, interchangeable parts, rapid assembly, and all those other features which go to make tremendous production possible.

Acetic Acid and Acetone from Beets

BOTH sour-milk and beet juice contain bacilli which possess the property of investing saccharose and producing lactic fermentation. Struck by this property an Italian scientist, Mr. G. Mezzadroli, conceived the idea that a direct means might be found herein of transforming the saccharose of beet-juice into lactic and acetic acids as by-products in the manufacture of alcohol and sugar. His experiments in this line covering a period of three years led to interesting results. We quote his conclusions from a summary in the *Bulletin* of the International Institute of Agriculture.

He divides the bacilli concerned into two classes, which he calls lactic invertors and acetic invertors. Beet juice containing about ten per cent of sugar was sterilized for half an hour at 120° C. then planted with a pure culture of lactic invertor bacilli and kept at a temperature of 36°-38° C. in the thermostat; at the end of a few hours the juice, brown at the beginning of the experiment, became clear, changing to an amber yellow. It is now highly acid, and if at this instant it be neutralized with perfectly sterile sodium carbonate, the fermentation continues briskly until a second neutralization becomes necessary, then a third, a fourth, etc. The sodium carbonate can be added all at the same time if desired, since a possible excess exerts no harmful effect either upon the fermentation or upon the final product, lactic acid. The dextro-rotation of the liquid constantly diminishes, later becoming sinister-rotation, and finally nil when nearly all the sugar has disappeared. One hundred grammes of saccharose taking part in the fermentation gave a yield of 60 to 80 per cent of lactic acid, 10 to 20 per cent of acetic acid, and 1 to 7 per cent of alcohol, with traces of acetone and the higher alcohols.

The lactic invertor bacilli gave a constant yield during the three years of experiment. It was found that some varities, however, lose their power of inverting saccharose during their passage through the solid medium of alkaline aga-glucose. Many others, on the contrary, keep their enzymatic properties intact, provided they are replaced in the same liquids from which they were originally selected.

Mr. Mezzodroli found that the acetic invertor bacilli were more efficacious than the preceding, but the yield of acetic acid does not as yet exceed that obtained in practice from acetic fermentation. One hundred parts of saccharose gave forty to fifty per cent of acetic acid, ten to twenty per cent of lactic acid, and one to two per cent of acetone. However, there is every indication that it will eventually be possible to obtain acetic acid directly from saccharose, without passing through the intermediate stage of alcohol. The application of the new process at present depends on the market price of acetic acid and of acetone. It is also possible to pass from lactic acid to acetic acid and thence to acetone by oxidization with hydrogen peroxide.

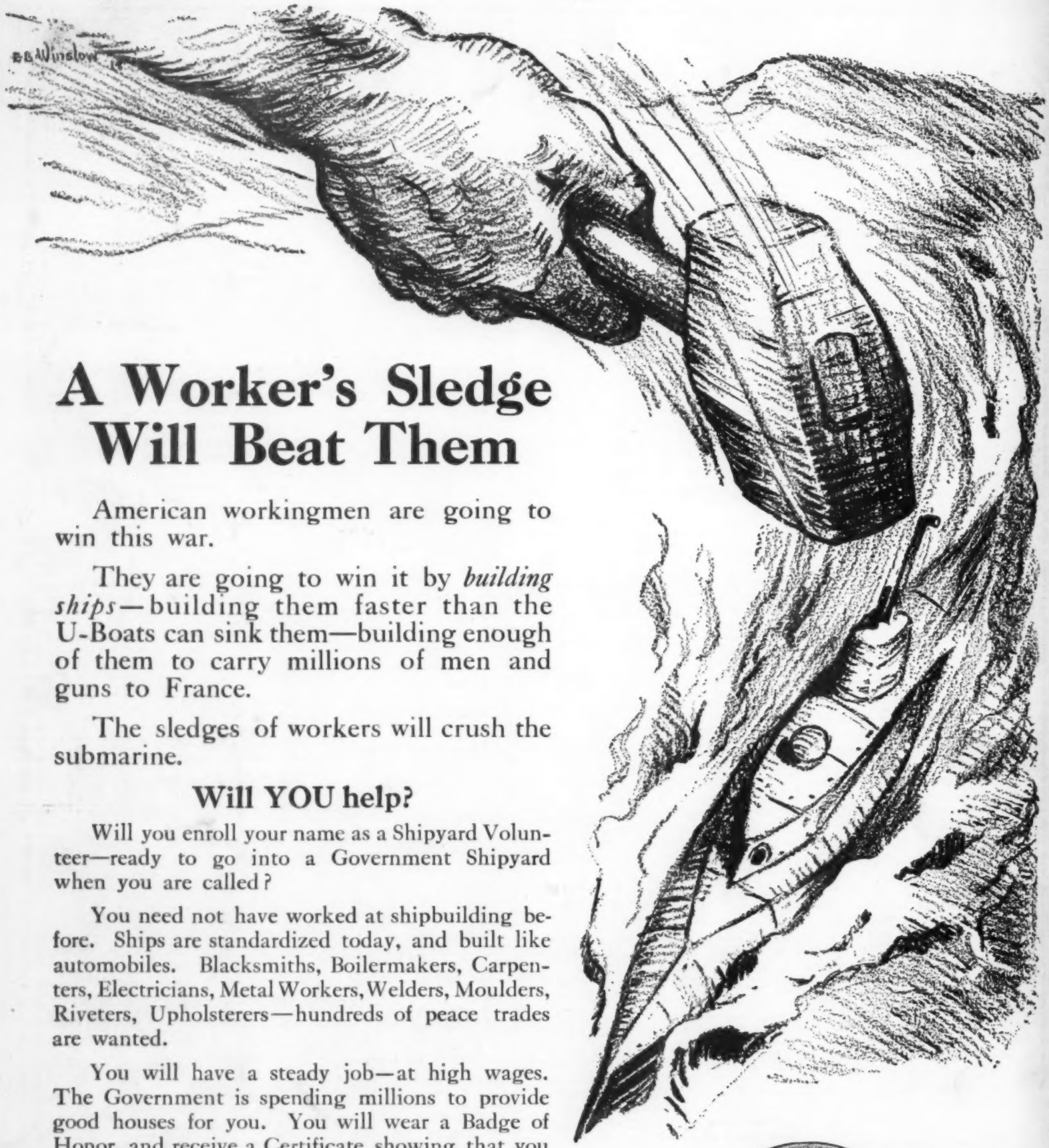
The aerobic macerating bacilli of the *type of B. asterosporus* resemble the preceding in their behavior. A variety furnished by Professor Carbone gave notable quantities of acetone, and it seems possible that by extended study of these bacilli and the seeking of other varieties one may be found of such marked acetonigenic properties as to serve as a basis of industrial manufacture.

"Cow on the Track" and Our Food Supply

THE joke about the cow on the track appears to be a rather grim one when considered in terms of all the railroads in the United States.

How many soldiers could be fed with the meat that is destroyed in one year by the killing of food animals on the railroad tracks of our country? The statistics are not available for a comprehensive answer to this question, but President Herbert of the St. Louis Southwestern has presented them in striking fashion for his road. A placard conspicuously posted in stations and offices sets forth the fact that the twelve months ending with June, 1917, witnessed the killing of 2,792 head of cattle, horses, and sheep on the lines of the Cotton Belt Route; and that the bodies of these animals, if they had been worked up in packing houses instead of being wasted on a railroad right of way, would have produced more than 1,000,000 pounds of food products—"or the equivalent of the meat ration of 70,000 soldiers for approximately 30 days." The placard tersely emphasizes the fact that this is not only an enormous waste of food, but also a drain on the resources of the railway company at a time when every dollar of its income should be used productively.

These figures are staggering. During the year in question, according to *The West at Work*, the Cotton Belt operated 1,809 miles of track. It is highly probable that many Western railroad systems could show a greater number of animals killed per 100 miles of line, in view of the fact that much of the St. Louis Southwestern mileage lies in the cotton country, where the production of food animals is small by comparison with that of such states as Missouri, Iowa, Illinois and Kansas.



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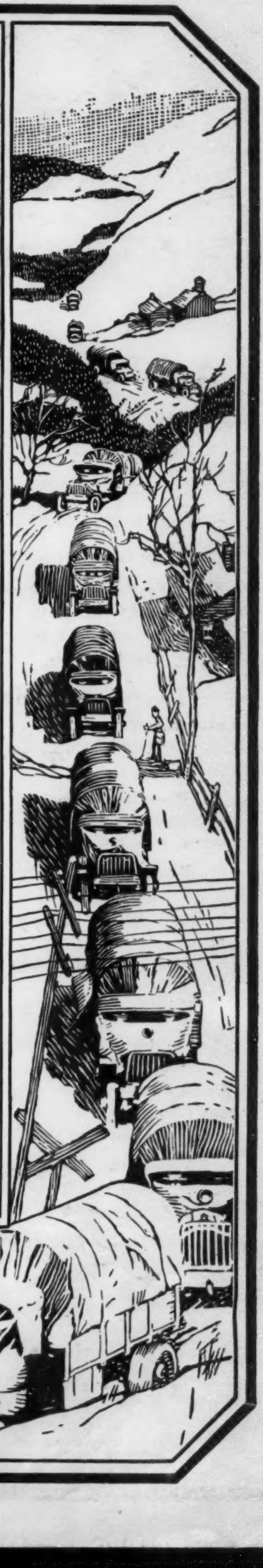

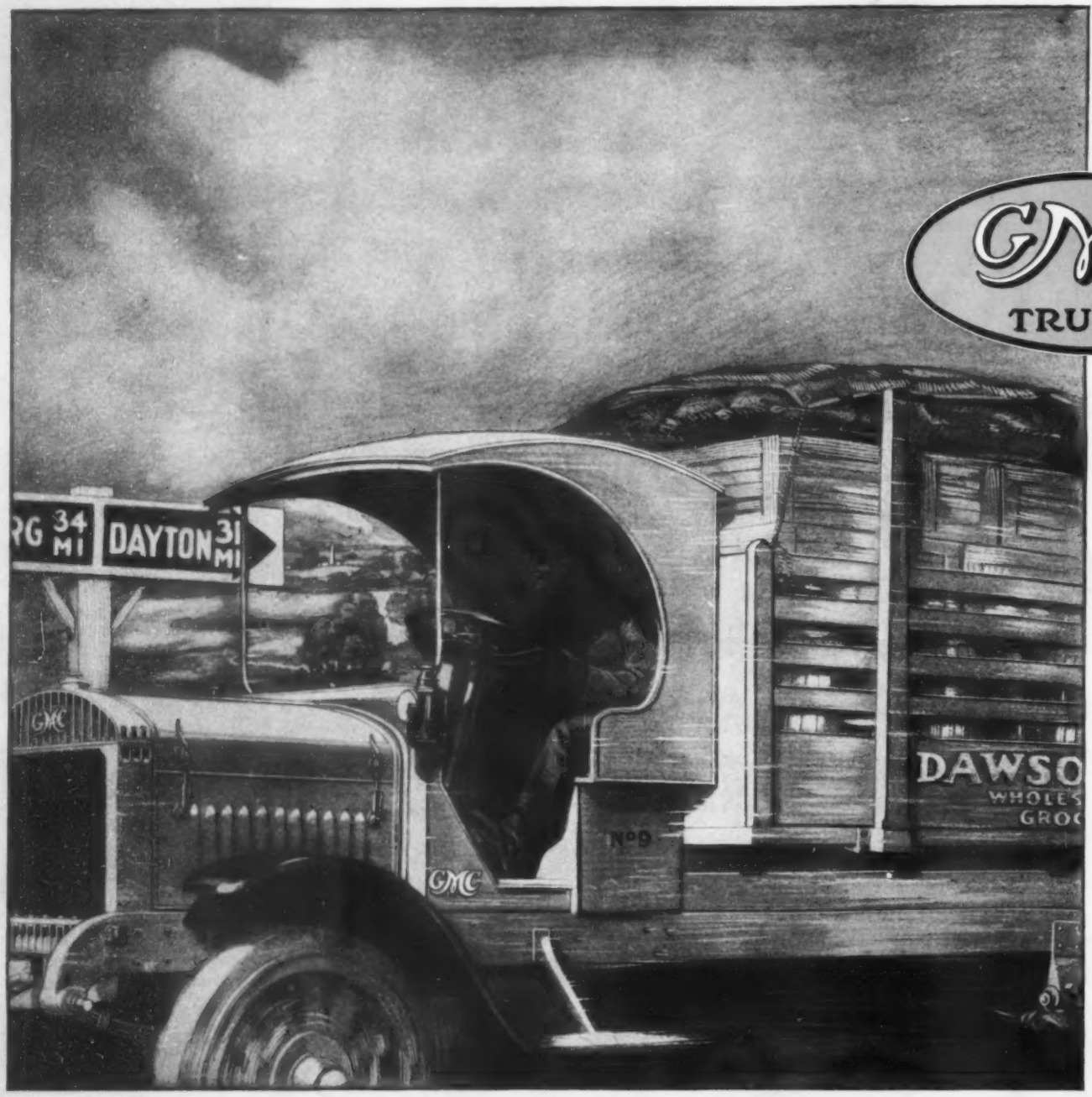

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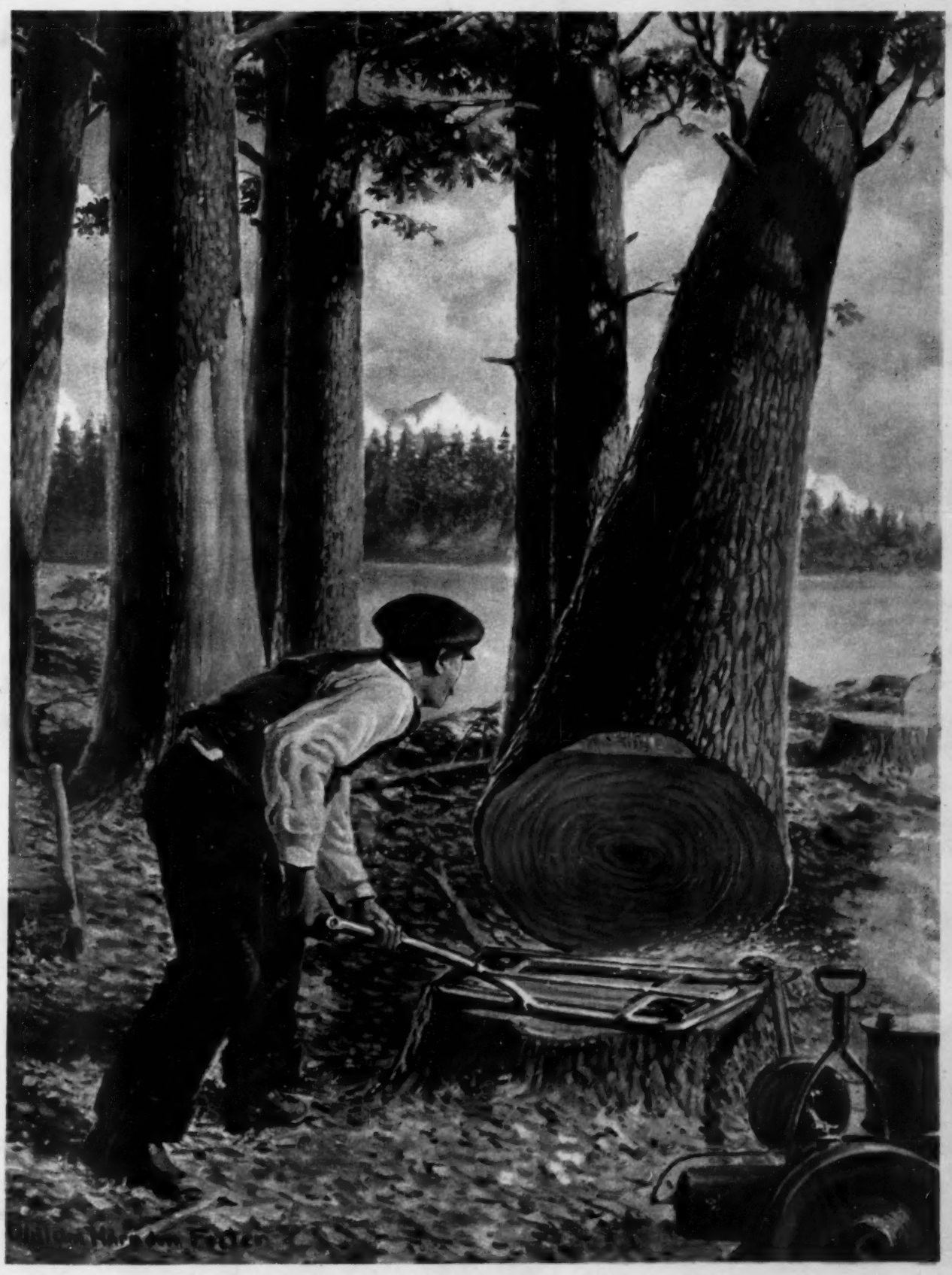

FELLING A TREE WITH A MOTOR-DRIVEN CHAIN SAW [See page 233]

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